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# ELECTRICITY ON FARMS *in Northwestern Washington*



UNITED STATES DEPARTMENT OF AGRICULTURE  
Bureau of Agricultural Economics  
in cooperation with  
THE STATE COLLEGE OF WASHINGTON  
Agricultural Experiment Stations



#### ERRATA SHEET

FIGURE 1, LOCATION OF STUDY AREA.--Negative No. 47766 should read 47768.

PAGE 17, FIGURE 5.--Regression equation " $y = 2159 + 173$ " should read " $y = 2159 + 173x$ ". Regression equation " $y = 1819 + 454$ " should read " $y = 1819 + .454x$ ". The latter equation gives the regression of electric power consumption and gross farm income grouped by size of dairy enterprise and is slightly different from the regression equation for dairy farms shown in figure 6, page 21, which was computed from ungrouped data.

Page 57, Figure 17.--Title and description of this chart apply to figure 18 on page 69

Page 69, Figure 18.--Title and description of this chart apply to figure 17 on page 57



# ELECTRICITY ON FARMS *in Northwestern Washington*



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UNITED STATES DEPARTMENT OF AGRICULTURE  
Bureau of Agricultural Economics

in cooperation with

THE STATE COLLEGE OF WASHINGTON  
Institute of Agricultural Sciences  
Agricultural Experiment Stations



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## **T H I S   R E P O R T**

is based on a study conducted by the Bureau of Agricultural Economics, United States Department of Agriculture, in cooperation with the Washington Agricultural Experiment Stations, the State College of Washington. It constitutes one in a series of studies in various parts of the country carried on under the over-all leadership and coordination of M. R. Cooper, Bureau of Agricultural Economics. Funds for this research project were provided in part under the Research and Marketing Act of 1946, with the remainder from regular Federal and State research funds.

A large number of farmers gave freely of their time and experience to provide the basic data in the field survey. Valuable assistance was given by the Puget Sound Power and Light Company, and particularly by its Division offices in Everett and Bellingham. These offices provided the data concerning consumption of power and revenues for individual farm customers from whom field records of uses made of electricity had been obtained. The field survey was under the immediate supervision of D. T. Griffith, formerly of the Bureau of Agricultural Economics.

In the tabulation and analysis of the data, the Bonneville Power Administration cooperated. The Administration also gave other valuable assistance and shared the costs of publication. Mention should be made especially of the assistance received from Herschel F. Jones and Bernard Goldhammer, Branch of Load Estimating, Division of Power Management.

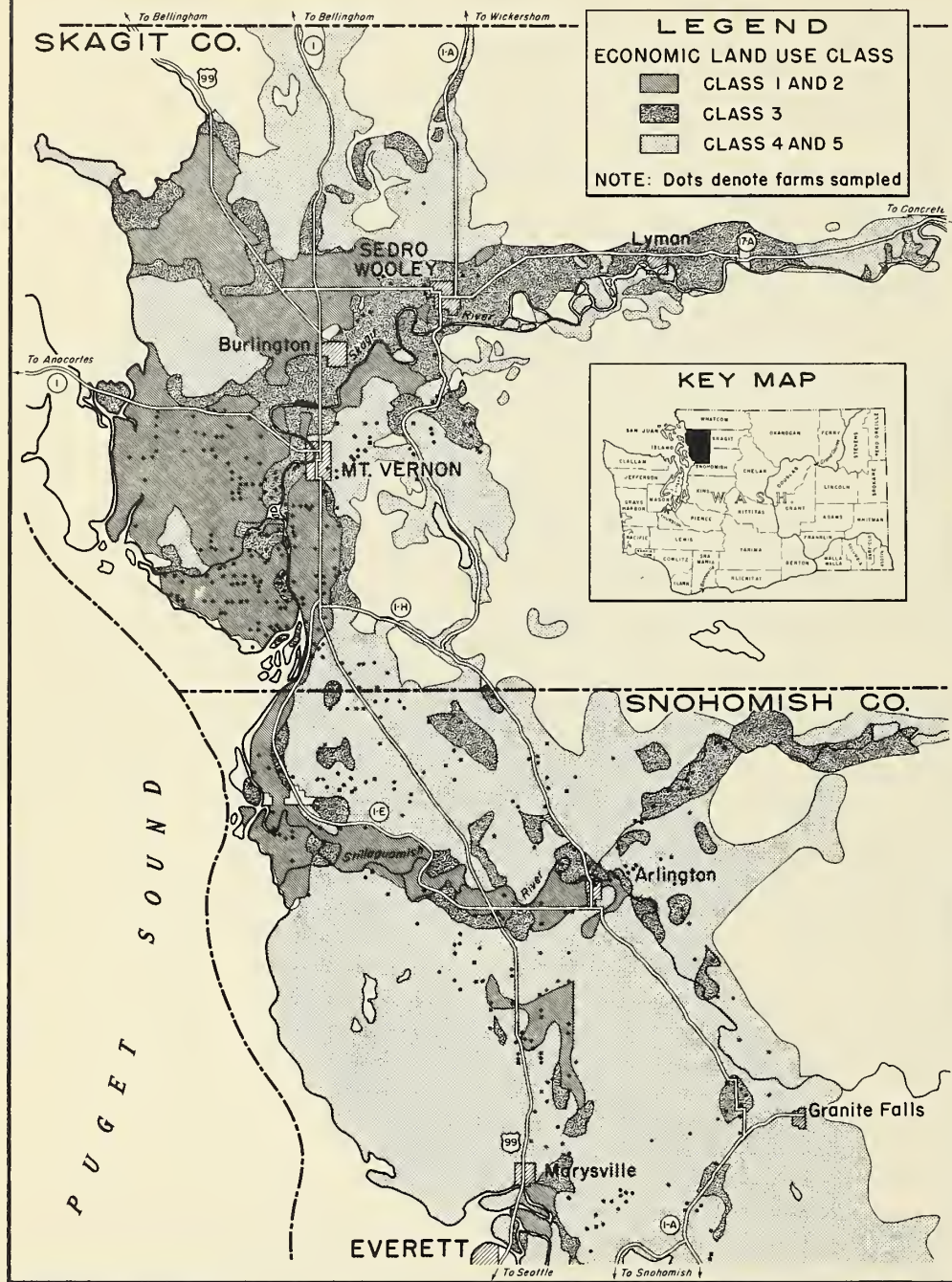
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# LOCATION OF STUDY AREA



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Figure 1. The study area is located between the Puget Sound and the Cascade mountain range in northwestern Washington. It is a predominantly dairy area including some of the most and some of the least productive land west of the Cascades.

# ELECTRICITY ON FARMS IN NORTHWESTERN WASHINGTON

By H. H. Stippler and A. W. Peterson <sup>1/</sup>

## INTRODUCTION

Use of electricity has increased rapidly during the last decade despite shortages of materials and appliances. Indications are that farm use of electricity from power lines has not only kept pace with urban residential use but in many cases has exceeded it. Although electric power is not as yet used directly in field operations, which constitute by far the major demand for farm power, it plays an important part in increasing the output and quality of those commodities that are produced primarily on or near the farmstead. As with other types of technological developments on farms, the use of electricity reduces physical labor per unit of production and thus increases productive capacity per man. Moreover, availability of electricity in the farm home, more than any other development, has eased the work of farm wives and has aided greatly in improving the level of living of farm families. Many of the values of electricity are difficult to express but, once experienced, most people are unwilling to be without them.

### Purpose of the Study and Selection of Area

Little information has been available until recently concerning uses of electricity, either in homes or on farms. Specifically, little is known as to the uses of electricity as related to the economic characteristics of farms; as to factors affecting the extent of use; as to changes in farm organization made as a result of availability of electric energy; and as to the cost of electricity to farmers. Information relating to these questions is needed if farmers and farm leaders are to keep abreast of modern developments in agricultural production. The information is needed also to provide a better basis for the extension of distribution lines into rural areas and for adjusting system design to meet the requirements of the area to be served. Finally, information is needed to indicate probable future growth in the use of electricity on farms as a part of the over-all planning process for adequate generating, transmission, and distribution facilities.

Studies to provide needed information were begun in 1947 in various type-of-farming areas of the country covering a variety of conditions. This report deals with the economic aspects of the use of electricity in an area predominantly devoted to dairy production.

Among the objectives of the study in northwestern Washington were determinations of the specific applications of electric energy on farms as related to the economic characteristics of these farms, of the historical trend both annual and seasonal, of the consumption of electric energy by types and sizes of farms and by economic land use classes, and an analysis of the cost of using electricity on farms.

Three factors influenced the selection of the first study area in the State of Washington. An area was wanted in which electricity had been available for a relatively long time, in which the farms were of types that had comparatively large opportunities for use of electricity in farming operations, and for which major differences in economic productivity of the land were adequately represented and had been mapped. An area in the southwestern part of Skagit County and the northwestern part of Snohomish County met these requirements. (See map, fig. 1).

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<sup>1/</sup> Agricultural economist, Bureau of Agricultural Economics, and Agricultural economist, Agricultural Experiment Station, State College of Washington, respectively.

### Description of the Area

The area selected is one of the oldest farming areas west of the Cascades and includes some of the most and some of the least productive land along the Coast. Land resources and climate favoring the production of forage crops, together with nearness to markets, have resulted in the production of fluid milk as the main individual farm enterprise. In areas which have large bodies of deep, well-drained soils, as for example, the La Conner and Stanwood areas, cash crops compete effectively with the dairy enterprise for land, labor, and other resources. One of these cash crops, green peas, is not only competitive, but supplemental to the dairy enterprise. The byproduct of the green pea enterprise, pea vine silage, is a desirable roughage for dairy cows. Specialized dairy farms are concentrated in the less well drained, or in other ways less productive lowlands.

There is strong competition with the dairy enterprise from vegetable seeds, bulbs, potatoes, and berries in years of relatively high prices for these specialty crops compared with those for milk. A rapidly rising price level and interference with normal imports had resulted in a favorable price for cash crops in general, but specifically for bulbs and vegetable seeds during and immediately following World War II. By the time this study was made these unusual factors were disappearing. However, their influence probably resulted in a higher acreage of cash crops in the area than will be normal in years immediately ahead. The long-time trend has been for oats, grass, and other forage crops to give way gradually to production of cash crops, especially on the most productive land. Even on less productive land, certain cash crops like caneberries and strawberries have shown increased acreages in recent years.

The West Coast generally is known for its highly developed poultry industry. In the production of poultry, concentrate feeds are usually purchased, thus the quality of the land is of minor importance. From 5 to 20 acres are adequate even for a large poultry enterprise. For these reasons, poultry enterprises are more numerous and often more specialized on the less productive land. In small numbers, they are also found intermingled with other types of farms on better land. In such cases, a cash crop is frequently grown to supplement the income from the poultry enterprise or the production of poultry is combined with dairy production. The type of poultry enterprise varies among individual units, from hatching operations and sale of replacement stock to production of eggs, fryers, broilers, and turkeys. The number of poultry farms and the size of individual operations fluctuate, depending chiefly upon the prevailing feed-price ratio and employment conditions in the city.

As is usually the case in farming areas that are adjacent to large population centers where opportunities for industrial employment are numerous, a relatively large number of part-time farms are scattered throughout, although they are found chiefly on the least productive land. In the localities that are more remote from population centers, a few small full-time farms on cut-over land of poor quality are at a subsistence level.

The productivity of the land resources and the intensity of their use are shown in figure 1. The basis for the delineation of land use areas within the study area is the economic land use classification made by the State College of Washington for several counties, including Skagit and Snohomish. <sup>2/</sup>

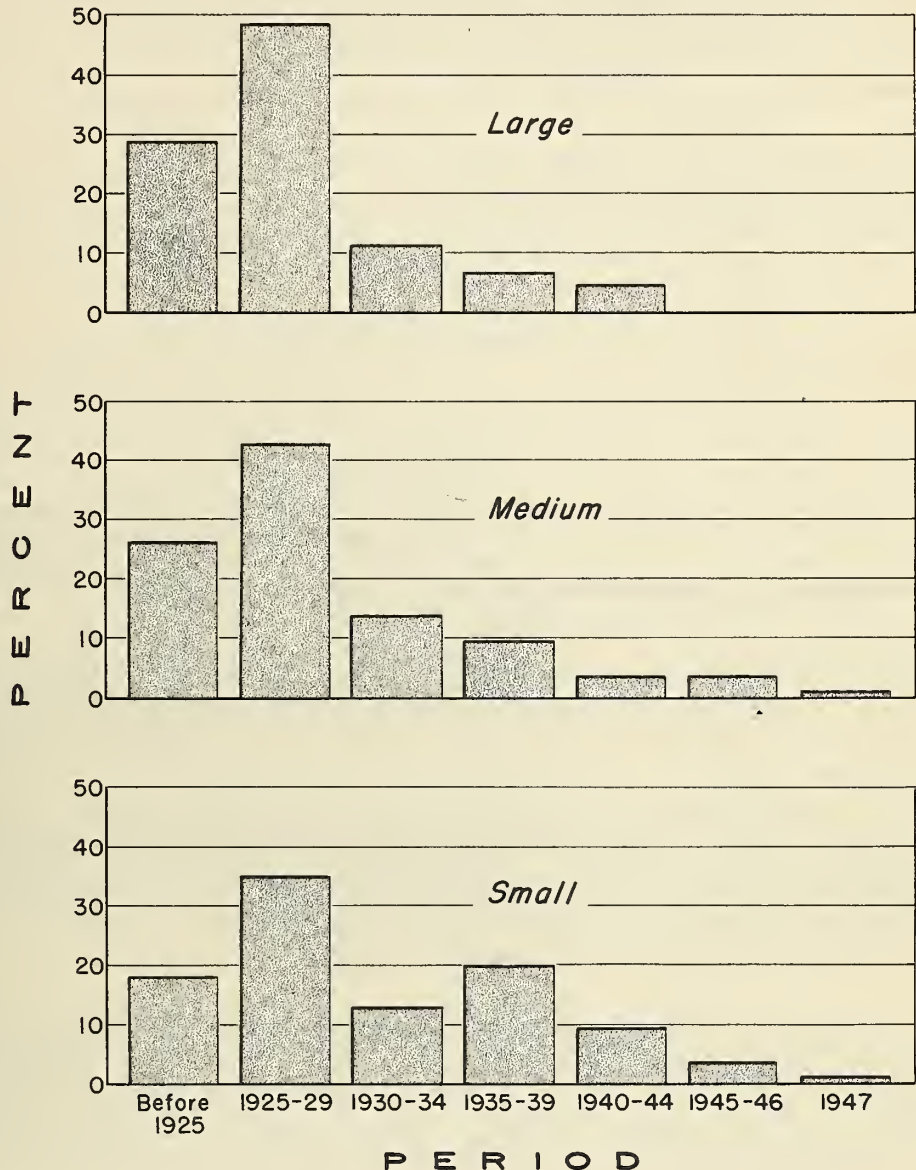
In the area, land use classes 1, 2, and 3 predominate in extent with only minor portions, particularly in the northwestern part of Snohomish County, of classes 4 and 5. On the other hand, the number of farms, particularly part-time farms, per square mile of area is relatively high on less productive land compared with the more productive land. Production of cash crops, except strawberries and caneberries, is confined

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<sup>2/</sup> See explanation of the economic land use classification, Appendix A.

# CONNECTION OF FARMS TO POWER LINES BY SIZE OF FARM

(NORTHWESTERN WASHINGTON)



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Figure 2. The largest proportion of farms were connected to power lines before 1930. A relatively small number, primarily small farms, have received electricity since that year.

almost entirely to the best land (classes 1 and 2). Dairy production is found primarily in average and above-average land use areas (classes 1, 2, and 3). Poultry production predominates on less productive land (classes 3, 4, and 5). The size of farm also varies according to the productivity of the land resources. In the more productive areas (classes 1 and 2), farms are generally larger than in less productive areas (classes 4 and 5).

The proximity of the study area to major population and industrial centers and the density of farms in the major portions suitable for agricultural production account for the fact that electricity has been available to the majority of farms for a considerable number of years. Another factor that has contributed to the early and widespread use of electricity on farms in this area is the rural electrification program of the Puget Sound Power and Light Company, which in 1909 "pioneered" one of the first distribution lines to serve farm homes. Except in a few cases where farms have been subdivided or new farms established through clearing or drainage, almost all farm connections to power lines date back to 1930 or earlier. In Skagit and Snohomish Counties, 90 percent of all farms included in the Census of 1945 reported electricity available in the farm dwelling, and 92 percent reported that they were within a quarter-mile of an electric power line. This compares with 86 percent of all farms in the State of Washington with electricity in the homes and 87 percent within a quarter-mile of a power line, or 48 and 60 percent, respectively, for the United States. In the study area itself, it is estimated that 95 percent or more of the farms are connected to electric power lines.

#### Sample Obtained

The total number of usable records obtained for the study included 481 farms. Of these, 231 were dairy farms--103 were poultry farms--89 were cash-crop farms--42 were classified as part-time farms--and 16 were of combination types or classified as subsistence farms. Of the total number, 46 percent were on land in economic land use classes 1 and 2, 23 percent in class 3, and 37 percent in classes 4 and 5.

The sample of 481 farms represents approximately 1-1/2 percent of the farms in the area. The sampling procedure used was dictated by the desire to obtain an adequate number of records for each major type and size of farm and for each economic land use class area. 3/

When it was desired to show results as to uses of electricity in such a way as to be representative of the situation in the area as a whole, data for individual groups were weighted 4/ by their proportionate representation in the area. If, for example, it was intended to show average consumption of electricity on all farms on class 3 land, the results for individual types and sizes of farms were weighted according to their proper representation in the area on that particular land class.

The number of all dairy farms in the sample represents fairly closely the proportionate number of all dairy farms in the area, although this is not the case for subgroupings. More than a proportionate share of poultry and cash-crop farms were included in the sample to obtain reliable data as to the use of electricity for individual groups, whereas the number of part-time and subsistence farms from which records were obtained was insufficient to represent these types in the proportions that they are found in the area.

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3/ See Appendix B, Sampling Procedure and Area Analysis.

4/ In all tables in which results for individual groups have been weighted by the existing distribution of farms as to type, size, and economic land class the word "weighted" appears in the heading of the table.

## ORGANIZATION OF FARMS AND CONSUMPTION OF ELECTRICITY

The uses of electricity on farms as related to the economic characteristics of these farms were emphasized in this study. The types of uses found in farm homes, that is, the types of home appliances, generally speaking, are not likely to differ a great deal from those in urban homes. Uses of electricity in farming operations, on the other hand, are determined primarily by the quality of land resources, types and sizes of the farm enterprises, and the resulting opportunities to use electricity in agricultural production. Farms on which livestock production is a major enterprise, particularly dairy and poultry farms, have greater opportunity to use electricity in the farm business than have cash-crop farms.

In the discussion that follows, the organization of farms by major types and sizes of farms and economic land use classes is discussed briefly. The results of the study as they apply to the area as a whole are then presented. In subsequent discussions, the uses of electricity on major types of farms are treated in greater detail.

### Organization of Farms

In the area, approximately 46 percent of all farms, or almost half, are dairy farms--that is, farms on which half or more of the gross farm income is derived from the sale of dairy products. Farms classified as large <sup>5/</sup> were more numerous on land classes 1 and 2 than on land class 3, or land classes 4 and 5. Utilization of available cropland and the average number of major kinds of livestock by type and size of farms and by economic land use classes are given in Appendix D.

The average acreage in farms in the area in 1947, weighted by their proper representation as to type, size, and economic land use classes, was 51.4 acres (table 1). This compares with an average size of 49.6 acres reported in the Census of Agriculture of 1945 for Skagit County and 31.1 acres for Snohomish County. Approximately 40 percent of the total land in farms in the area was cultivated and an additional 29 percent was in plowable pasture.

Of the three major types of farms--dairy, poultry, and cash-crop--the third had the highest proportion of cultivated land. This type of farm was also largest in average size. Poultry farms had a relatively small acreage of cultivated land and their average size was relatively small. They compared in size, as expressed in acreage, with part-time and subsistence farms. Dairy farms averaged twice as large in over-all size as poultry farms, and a larger proportion of the land was cultivated or used for pastures.

The average large farm of all types, as measured by productive man-work units, had 78.4 acres or 55 percent of the total in cultivated land, 34 acres or 24 percent in plowable pastures, and 29 acres or 21 percent in woodland, waste, farmstead, etc. A medium-sized farm of all types averaged 71 acres, of which 43 percent was cultivated, and a small farm averaged 34 acres, of which 30 percent was cultivated. Thus, the proportion of the total land in farms which was cultivated declined as the size of farm decreased. On large farms, the acreage of plowable pasture was relatively small. Medium-sized farms had slightly more than a third, while small farms had 29 percent of the total land in plowable pasture.

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<sup>5/</sup> In order to compare farms of different types as to size of farm business, a size classification on the basis of productive man-work units (PMWU) was chosen. See Appendix C.

Variations were also found in the size of farm expressed in acreage by various land use classes. On land classes 1 and 2, the weighted average size of farm was 72 acres, of which 58 percent was cultivated. On land class 3, farms averaged 54 acres in size, of which a smaller proportion (34 percent) was cultivated. On land classes 4 and 5, the size of farm was 41 acres, of which 11 acres, or 27 percent, were cultivated. Thus, size of farm as well as proportion of land cultivated declined as land resources became less productive.

Table 1.- Weighted average acreage per farm of land in crops, cropland and plowable pasture, and total land in farms, by type and size of farm and economic land use class, northwestern Washington

Item	: Dairy	: Poultry	: Cash-: Part-: Sub- : All	: crop : time : sistence : types		
	: Acres	: Acres	: Acres	: Acres	: Acres	: Acres
	Cultivated land, total land in crops					
Size of farm						
Large . . . . .	65.1	11.3	121.9	---	---	78.4
Medium . . . . .	27.2	6.4	70.7	---	---	30.4
Small . . . . .	12.8	3.4	29.8	7.1	10.3	10.2
Land use						
Classes 1 and 2 . . . . .	29.8	7.5	91.5	3.8	---	42.0
Class 3 . . . . .	22.2	18.9	23.0	7.6	---	18.3
Classes 4 and 5 . . . . .	16.0	4.4	---	7.7	10.3	11.0
All farms . . . . .	21.6	6.5	86.6	7.1	10.3	20.5
	Cropland and plowable pasture					
Size of farm						
Large . . . . .	113.9	29.8	147.4	---	---	112.4
Medium . . . . .	53.3	14.6	99.9	---	---	54.4
Small . . . . .	27.6	8.5	36.6	13.6	17.3	20.0
Land use						
Classes 1 and 2 . . . . .	53.7	10.5	116.2	5.4	---	61.8
Class 3 . . . . .	45.5	28.1	27.8	16.2	---	36.4
Classes 4 and 5 . . . . .	34.2	15.0	---	14.9	17.3	22.7
All farms . . . . .	42.7	16.0	110.0	13.6	17.3	35.3
	Total land operated					
Size of farm						
Large . . . . .	151.9	58.4	167.2	---	---	141.4
Medium . . . . .	72.3	29.1	106.5	---	---	71.0
Small . . . . .	45.3	16.0	39.8	26.9	27.3	34.2
Land use						
Classes 1 and 2 . . . . .	65.3	13.2	129.0	10.1	---	72.3
Class 3 . . . . .	60.2	40.6	30.5	43.8	---	53.9
Classes 4 and 5 . . . . .	61.7	32.8	---	27.1	27.3	40.8
All farms . . . . .	62.5	31.4	122.0	26.9	27.3	51.4

### Length of Time Electricity Has Been Available

Accurate dates regarding the time of connection of individual farms to power lines were difficult to obtain. The power lines were constructed many years ago and the power companies retain records for the most recent 10 years only. In the part of the area that lies in Skagit County, only three main distribution lines were built between 1925 and 1929; all others were constructed between 1917 and 1922. Thus, of the 205 farms in this county for which records were obtained, 180 or 88 percent, were connected to lines which were built before 1925. In the part of the area that is located in Snohomish County, the major distribution lines were built between 1922 and 1926, but most of the farms were connected to lines built before 1925. Generally speaking, the first rural lines were built in areas of relatively high productive resources (land classes 1 and 2) close to urban or industrial load centers, while later constructions were carried out in the less productive and more scattered areas. Dairy and cash-crop farms located on the better land generally had an early opportunity to use electricity; poultry and part-time farms, which are located primarily in areas of less productive resources, received electric service at a later date.

Nor was the date of connection as reported by the farmer found to be accurate in all cases. Almost a fourth (22 percent) of the interviewed farmers could not recall the original date of connection; others apparently reported the date they moved to the farm or the first use of electricity in the farm business. For example, for 14 of the 37 farms which reportedly were connected after 1939, the records of power consumption from the distributor were available for the full 10-year period 1938-47. This indicates that the dates reported by farmers in some cases were not the original dates of connection of the farm and that the information should be used with caution.

Of those farms for which the original date of connection was given by the operator 64 percent reported that the connection was made in 1929 or earlier years, and 23 percent reported the date to be earlier than 1925 (fig. 2 and table 51, page 86). More than three-fourths of the farms located in land class 1 and 2 areas were connected before 1930 and the proportion of large farms in these areas was even greater (87 percent). In land class 3 areas, 58 percent of the farms reporting were connected before 1930, while in poorer locations (land classes 4 and 5) only half of the farms reported connections before that date.

In view of the length of time service has been available to most farms and the questionable accuracy of some of the data obtained, analyses of uses of electricity and average consumption of power in relation to the length of time service has been available are apparently less significant for this area than for other areas where farm connections have been more recent. However, in the discussions that follow, the results of an analysis of average consumption of electricity on medium-sized dairy farms in relation to the date of connection are given.

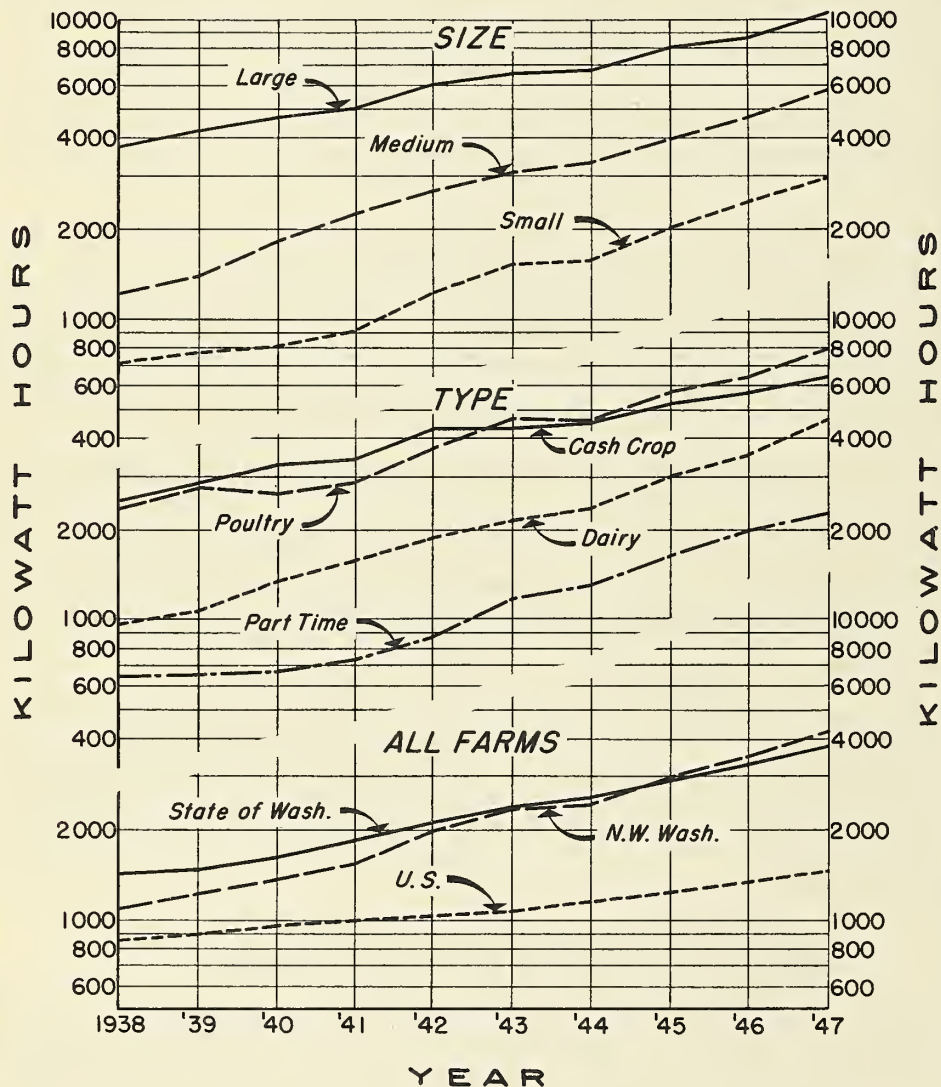
### Annual Use of Electricity on Farms in the Area, 1938-47

Consumption of electricity on farms in northwestern Washington during the last 10 years has increased rapidly. The rate of growth was considerably greater than is indicated for all residential users in urban and rural areas of the State, or in the Nation as a whole. This is primarily because service has been available for a relatively long time, farm income has been favorable to an expansion in the use of electricity, and farmers in general have greater opportunities for using electricity than have most other residential users.

In the later discussions of the level of consumption of electricity in the area, the results of individual groups were weighted by the proportionate distribution as to types and sizes of farms and economic land use classes represented in the area in 1947. Thus,

# ANNUAL CONSUMPTION OF ELECTRICITY BY SIZE AND TYPE OF FARM

(NORTHWESTERN WASHINGTON 1938-47)



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Figure 3. Consumption of electricity on these farms, weighted by their proper representation in the area, increased rapidly during the 10-year period 1938-47. The rate of increase on farms exceeded that of all residential consumers in the State and in the Nation as a whole.

average consumption for a given type of farm or for one particular economic land use class was weighted by sizes or types of farms or economic land use classes, as the case may be. 6/

Weighted average annual consumption of electricity on all farms in the study area increased during the 10-year period 1938-47 from 1,080 kilowatt-hours (kw.-hrs.) to 4,240 kw.-hrs., or almost four times (fig. 3, table 2, and table 52, page 88 ). This compares with an increase in the average consumption for all residential users in the State of Washington from 1,409 kw.-hrs. in 1938 to 3,808 in 1947, or slightly less than 2-3/4 times, and that for the United States as a whole from 852 kw.-hrs. in 1938 to 1,438 in 1947, an increase of 69 percent. Although on farms in the area average consumption in 1938 was 23 percent below the average for all residential consumers in the State, it exceeded this for the first time in 1945 and in 1947 it rose to 11 percent above the State average. Except for the increase in consumption from 1940 to 1941 and 1943 to 1944, annual rate of increase on farms in the area exceeded the annual rate of increase for the State as a whole. Particularly during the period 1944-47, the annual growth in average consumption of power on farms, which ranged from 17 to 25 percent for individual years, was considerably larger than that for the State as a whole, which showed an annual rate of increase of 14 percent. The latter rate was exceeded only slightly during the first year of World War II.

Major variations in consumption of electricity were found between different sizes of farms (table 2). In 1938 large farms had already attained a level of consumption considerably higher than that of medium and small farms. Generally higher farm incomes, larger farm homes for the operator, and sometimes one or more additional homes on a farm for year-round hired workers are the primary reasons for more household appliances in use as the size of farm increases. Large farms also have greater opportunities to employ electric farm appliances profitably. On a given farm with a dairy enterprise of 20 or more milk cows, the saving in labor costs obtained in machine milking as compared with hand milking may be expected to justify investment in a milking machine and to pay the current maintenance and operating costs as well. On a small farm with a dairy enterprise of fewer than 5 milk cows, the saving in labor and other advantages obtained through machine milking over hand milking may not justify investment in and operating costs of a milking machine. Although the time saved per cow varies only a little, depending upon the size of the herd, the total time saved in milking 5 cows, compared with milking 20 cows, particularly if this time cannot be used profitably in any other way, may not be enough to justify the purchase and maintenance of a milking machine. In other words, unless the total saving in time or other advantages of one method which involves high investments exceed those of another method which involves low investments, the change is not justified on an economic basis.

For each year during the 10-year period 1938-47, the average consumption of electricity for each type of large farm was greater than that of any type of medium-sized farm. The average consumption for medium-sized dairy farms, however, was exceeded in some years by small poultry or cash-crop farms. In 1938, the weighted average consumption of electricity on large farms was more than three times as high as that on medium-sized farms, while that on medium-sized farms was only 70 percent above the average consumption on small farms.

This situation changed somewhat during the succeeding 9 years. Large farms increased their consumption to more than 10,000 kw.-hrs. or by 184 percent, whereas on medium-sized farms the consumption was more than 4-3/4 times as large in 1947 as in 1938. Small farms also showed a higher rate of increase in average consumption than large farms. Consumption of electricity on these farms in 1947 was almost 4-1/4 times that in 1938. Thus, by 1947, average consumption on large farms was only 48 percent above that on medium-sized farms, whereas the spread between medium and small

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6/ See Appendix B, pages 81 and 82.

Table 2.- Weighted average consumption of electricity per farm, by size and type of farm, and economic land use, northwestern Washington, 1938-47.

Item	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	Increase 1947 over 1938
	Kw.- hrs.	Kw.- hrs.	Kw.- hrs.	Kw.- hrs.	Kw.- hrs.	Kw.- hrs.	Kw.- hrs.	Kw.- hrs.	Kw.- hrs.	Kw.- hrs.	Percent
Size of farm											
Large.....	3,714	4,207	4,736	5,021	6,039	6,596	6,796	8,118	8,750	10,549	184
Medium.....	1,203	1,400	1,824	2,227	2,697	3,069	3,307	3,986	4,754	5,817	384
Small.....	706	775	806	908	1,258	1,565	1,580	2,055	2,472	2,982	322
Type of farm											
Dairy.....	961	1,073	1,325	1,578	1,847	2,117	2,353	2,999	3,586	4,620	381
Poultry.....	2,360	2,774	2,629	2,857	3,745	4,765	4,607	5,756	6,469	7,997	239
Cash-crop.....	2,501	2,836	3,256	3,405	4,339	4,386	4,587	5,224	5,729	6,467	159
Part-time.....	644	658	675	734	874	1,173	1,308	1,664	1,981	2,260	251
Subsistence.....	874	1,110	1,210	1,383	2,738	3,332	2,544	3,158	3,706	3,860	342
Land use											
Classes 1 and 2.....	1,808	1,919	2,283	2,680	3,139	3,318	3,613	4,264	4,997	5,979	231
Class 3.....	1,109	1,396	1,529	1,596	1,888	2,183	2,327	3,068	3,420	4,089	269
Classes 4 and 5.....	732	834	898	1,006	1,471	1,904	1,859	2,384	2,828	3,471	374
All farms											
Northwestern Washington.....	1,080	1,213	1,368	1,547	1,982	2,325	2,402	2,995	3,502	4,240	293
Washington 1/.....	1,409	1,469	1,604	1,834	2,103	2,358	2,581	2,934	3,339	3,808	170
United States 1/.....	853	897	952	986	1,022	1,070	1,151	1,229	1,329	1,438	69

1/ Average residential use, computed from data in Edison Electric Institute, Statistical Bulletin, 1938-1947.

farms had widened to a point at which consumption on medium-sized farms was more than twice that on small farms. Obviously, the increase in kilowatt-hours was greatest on large farms, whereas on medium and small farms the addition of only a few appliances brought a substantial increase in the rate of growth, as in 1938 the consumption of electricity was relatively small.

The considerable differences in level of consumption and rate of growth are also indicated by type of farm (table 53, page 89 ). Average annual consumption on poultry farms, weighted again by their proper representation as to sizes and location within the area, was higher during the period 1943-47 than that of either dairy or cash-crop farms. Before 1943, annual consumption on cash-crop farms exceeded that on any other type of farm. The increase in consumption among the major types of commercial farms, over the 10-year period, in absolute amounts was greatest on poultry farms, followed by cash-crop and dairy farms. Proportionate to the level of consumption attained in 1938, however, dairy farms made greater gains than either poultry or cash-crop farms. Of the so-called noncommercial types of farms, subsistence units showed the greatest gains. For this type, the small number of farms in the sample introduces doubt as to the reliability of the data obtained. Part-time farms had the smallest actual increase over the 10-year period, but because of the low level of consumption in 1938, the percentage increase is only slightly below that for all farms in the area.

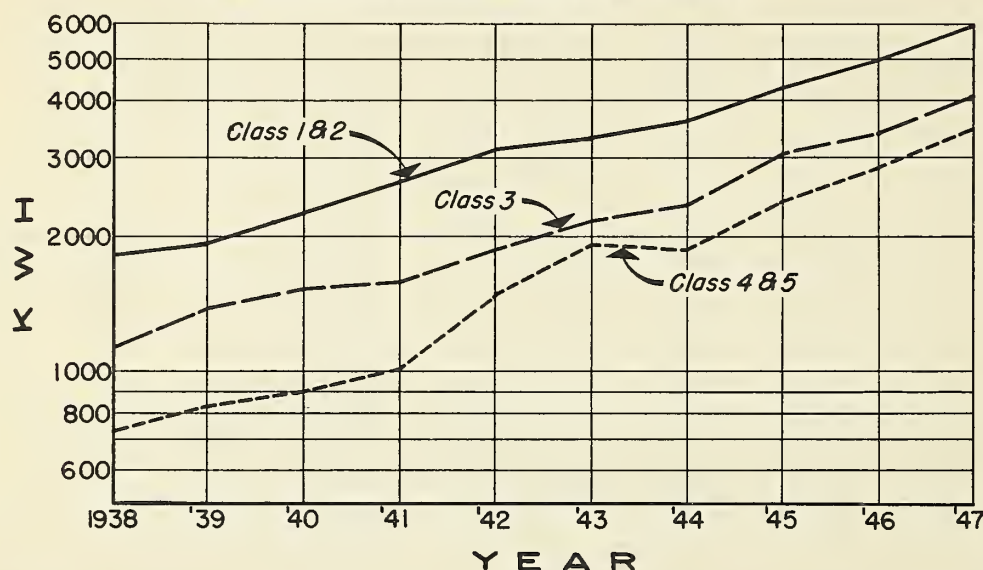
Weighted average consumption of electricity by types of farms represented in the area is influenced considerably by the distribution of farms as to size. For example, average annual consumption of power on dairy farms, as given in table 2, is lower than that on other types of so-called commercial farms. More than 60 percent of the dairy farms in the area are small. Therefore, the fact that the use of electricity on dairy farms in the large and medium-sized groups exceeded that on cash-crop farms and in the small farm group exceeded consumption on poultry farms is not reflected in the averages of all farms of a given type. For cash-crop farms, large and medium sizes predominate and, although average consumption for these sizes is lower than for comparable sizes of other types of farms, the average consumption of all cash-crop farms in the area exceeds that of dairy farms. The average rate of growth on cash-crop farms was the lowest of any type in the area. Because of these differences in the level of consumption in relation to the distribution of types and sizes of farms in the area, greater weight must be laid on an analysis of the uses of electricity on individual types and sizes of farms.

The various types and sizes of farming operations found in an area are to a considerable extent the result of existing natural conditions, including soil resources, climate, and other factors. Although location in relation to markets frequently modifies the distribution of types and sizes based on natural conditions, it is of decreasing influence as modern methods of transportation make further advances. Generally speaking, intensive types of production and large and medium sizes of operations tend to concentrate in areas of above-average resources, whereas extensive types of land use and relatively small sizes of operations tend toward resources that are below the average of an area. Therefore, a close relationship exists between the types and sizes of farms found in an area and the productivity of the land resources as expressed in an economic land use classification.

In the study area, 70 percent of all large farms were located within land use classes 1 and 2, compared with 52 percent of the medium sizes and 14 percent of the small farms. On the other hand, 16 percent of all large farms, 31 percent of the medium-sized farms, and 70 percent of the small farms were located in land classes 4 and 5. Furthermore, cash-crop and dairy farms were found primarily on the better land, whereas poultry and part-time farms are concentrated in poorer locations. Thus, differences in the level of consumption of electricity and in the rate of growth by land use classes as illustrated in figure 4 and presented in table 2 (page 10) and table 53 (page 89 ), are the combined results of the distribution of types and sizes of farms as well as the productivity of the resources.

## ANNUAL CONSUMPTION OF ELECTRICITY ON FARMS BY ECONOMIC LAND USE CLASSES

(NORTHWESTERN WASHINGTON 1938-47)



U.S. DEPARTMENT OF AGRICULTURE

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Figure 4. Actual increase in consumption of electricity was greatest on farms located in the most productive areas. The average rate of increase during the 10-year period, however, was greatest on farms located in average or below-average locations.

In 1938, average consumption on all farms in land class areas 1 and 2, which represent the more productive resources, was 63 percent above that on land class 3, which in turn was 52 percent greater than that on farms in land classes 4 and 5. As the rate of growth in consumption of power during the 10-year period 1938-47 varied considerably among types and sizes of farms, depending upon the level attained in 1938 and the distribution of farms by land classes, the rate of growth by land classes increased as the productivity of the resources declined. In absolute amounts, the increase in consumption in land class 1 and 2 areas, however, was considerably greater than that in average or below-average land class areas. In 1947, consumption on farms in land classes 1 and 2 was 46 percent above that in land class 3, while consumption in land class 3 was only 18 percent above that in land classes 4 and 5 areas.

In general, average consumption of electricity is lower for individual types of farms located on less productive land, compared with the same type on the better land. But because of the lower level of consumption on land classes 4 and 5 in 1938, the rate of growth during the 10-year period for a given type is frequently higher than in the better locations. As poultry farms tend toward less productive land resources but have a relatively high consumption of electricity, particularly if large, they raise the average consumption on the lower land classes in some cases above the average on the higher land classes. This is particularly true on large farms of all types in the various land use classes. Average consumption on all large farms in land use classes 4 and 5 was 45 percent above that on land class 3, which in turn was 9 percent above that in land classes 1 and 2. This tendency for average consumption on farms in the lower land classes to exceed that in better locations disappears as the size of farm decreases.

Average annual consumption of electricity by type of tenure as classified for 1947 does not indicate significant and consistent differences either in level of consumption or rate of growth between owner- and tenant-operated farms.

Table 3.- Percentage distribution of farms by tenure, size, and type of farm and economic land use, northwestern Washington, 1947.

Item	All farms	Percentage of all farms		
		Full owner	Part-owner	Tenant
	Number	Percent	Percent	Percent
Size of farm				
Large . . . . .	107	65.4	22.4	12.2
Medium . . . . .	155	72.9	12.3	14.8
Small . . . . .	219	92.2	5.5	2.3
Type of farm				
Dairy . . . . .	231	78.3	11.7	10.0
Poultry . . . . .	103	91.3	6.8	1.9
Cash-crop . . . . .	89	67.4	19.1	13.5
Part-time . . . . .	42	95.2	2.4	2.4
Subsistence . . . . .	3	100.0	---	---
Miscellaneous . . . . .	13	53.8	23.1	23.1
Land use				
Classes 1 and 2 . . . . .	195	70.3	16.4	13.3
Class 3 . . . . .	110	85.4	8.2	6.4
Classes 4 and 5 . . . . .	176	87.5	8.0	4.5
All farms . . . . .	481	80.1	11.4	8.5

Most of the farms included in the study (80 percent) were operated by their owners. Part-owners operated slightly more than 11 percent and tenants 8.5 percent of the farms (table 3 and table 54, page 90 ). Ownership was highest on poultry and part-time farms, whereas cash-crop and dairy farms were the only types showing any considerable degree of tenancy. Medium-sized farms of all types combined had a higher proportion of tenancy than large farms. But the latter had a higher proportion of farms operated by part-owners. Thus, full ownership increased as the size of farm decreased. Full ownership also increased as the productivity of the resources declined. In the more productive areas (land classes 1 and 2), part ownership and tenancy was relatively more important than on less productive land.

Consumption of electricity on all owner-operated farms in the sample was below that on tenant-operated farms and considerably below the level of consumption on farms operated by part-owners (table 4 and table 55, page 91 ). The average annual rate of growth during the 10-year period 1938-47, however, was proportionately greater on these than on part-owner or tenant-operated farms. As pointed out previously, farms which in 1938 had attained a fairly high level of consumption, whether large or of a type that could make extensive use of electricity, gained more in actual consumption expressed in kilowatt-hours, but by 1947 had gained less proportionately than farms that had a lower level of consumption in 1938. Thus, neither the rate of increase in consumption during the decade nor the level of consumption attained in 1947 seems to have been affected by the tenure status of the operator.

Table 4.- Average consumption of electricity per farm, by type of tenure, northwestern Washington, 1938-47.

Item	Unit	Full owner	Part owner	Tenant
Farms . . . . .	Number	385	55	41
1938 . . . . .	Kilowatt-hour	1,518	2,456	1,819
1939 . . . . .	do.	1,725	2,734	2,135
1940 . . . . .	do.	1,899	3,070	2,628
1941 . . . . .	do.	2,170	3,020	3,095
1942 . . . . .	do.	2,687	3,506	3,306
1943 . . . . .	do.	3,095	4,311	3,782
1944 . . . . .	do.	3,239	4,610	3,540
1945 . . . . .	do.	3,934	5,729	4,168
1946 . . . . .	do.	4,526	6,252	4,533
1947 . . . . .	do.	5,512	7,664	6,198
Increase 1947 over 1938				
Actual . . . . .	do.	3,994	5,208	4,379
Percent . . . . .	Percent	263	212	241

In order to eliminate the effect of types and sizes of farms upon the level of consumption, results for the three types of tenure of a specific group for which the sample is sufficiently large--medium-sized dairy farms--are shown separately in table 5.

Table 5.- Average consumption of electricity on medium-sized dairy farms, by tenure, northwestern Washington, 1938-47

Item	Unit	Full owner	Part owner	Tenant
Farms . . . . .	Number	71	12	13
1938 . . . . .	Kilowatt-hour	952	692	1,249
1939 . . . . .	do.	1,192	706	1,391
1940 . . . . .	do.	1,617	1,118	2,067
1941 . . . . .	do.	1,916	1,735	3,139
1942 . . . . .	do.	2,257	2,478	3,422
1943 . . . . .	do.	2,586	2,787	3,884
1944 . . . . .	do.	3,098	3,151	3,478
1945 . . . . .	do.	3,696	3,695	4,434
1946 . . . . .	do.	4,258	4,568	5,158
1947 . . . . .	do.	5,665	5,751	5,902
Increase 1947 over 1938				
Actual . . . . .	do.	4,713	5,059	4,653
Percent . . . . .	Percent	495	731	373

Although tenant-operated dairy farms of medium size had the highest consumption in 1938 and retained this position throughout the 10-year period, part-owner and owner-operated farms made greater progress in the use of electricity during the period. By 1947, this had largely eliminated the differences in the level of consumption. There is no basis for assuming that tenants or landlords have been more or less slow in making investments in electric appliances.

In this connection it should be pointed out that a particular type of tenure is not a permanent characteristic of farms. The tenure may actually have changed on some farms within the period covered by this study. Furthermore, tenancy is associated with the best land and in the area many of the tenants are related to the landowners and act more nearly like owners.

Average annual consumption of electricity by date of farm connection is given here for one particular group of farms. This is done to eliminate variations in the level of consumption and the rate of growth which are caused primarily by type and size rather than by the length of time service has been available. Again, medium-sized dairy farms, the largest individual group of farms for which information regarding the original date of farm connection was obtained, were chosen. Results of the comparison in average annual consumption of electricity by dates of farm connection are presented in table 6.

Table 6.- Average annual consumption of electricity on medium-sized dairy farms connected to power lines during specified periods, northwestern Washington, 1938-47

Item	Unit	Period of farm connection						
		Before : 1925 :	1925- : 29 :	1930- : 34 :	1935- : 39 :	1940- : 44 :	1945- : 46 :	1947
Farms . . .	Number	20	30	14	6	1	3	1
1938 . . . .	Kilowatt-hour	819	1,126	1,170	729	---	---	---
1939 . . . .	do.	891	1,370	1,508	953	---	---	---
1940 . . . .	do.	1,224	1,879	1,954	889	---	---	---
1941 . . . .	do.	1,780	2,045	2,596	1,459	---	---	---
1942 . . . .	do.	1,688	2,452	3,008	1,760	---	---	---
1943 . . . .	do.	2,182	2,671	3,458	2,499	---	---	---
1944 . . . .	do.	2,735	3,261	3,892	2,661	---	---	---
1945 . . . .	do.	3,309	3,912	4,947	2,855	2,650	---	---
1946 . . . .	do.	3,711	4,361	5,315	4,098	4,166	2,802	---
1947 . . . .	do.	5,318	5,717	6,353	6,436	10,375	6,950	3,502
Increase								
1947 over								
1938								
Actual . .	do.	4,499	4,591	5,183	5,707	7,725	4,148	---
Percent . .	Percent	549	408	443	783	292	148	---

In an area in which service has been available for a relatively long time, power consumption apparently does not vary according to the length of time the farm has been connected.

Other factors appear to have had a greater effect upon consumption. The number of farms connected since 1940 is too small to permit valid conclusions to be drawn. Consumption on farms connected before 1940 does not indicate variations related to the date

of farm connection. In fact, farms of more recent connection (1935-39) had reached a higher average level of consumption in 1947 and showed a higher rate of growth during the 10-year period than farms of earlier connection.

### Consumption of Electricity in 1947 Related to Farm Organization and Income

In the preceding discussions, main emphasis has been placed upon the historical trend in the consumption of electricity on farms in relation to various farm characteristics. Measures other than those of type, size, land use class, etc., that apply more specifically to the year 1947, are used here in order to learn their influence upon the level of consumption reached during that year.

Consumption of electricity on farms in the area in 1947 may be presented in relation to the acreage of land in farms. This is not the most desirable method to present the level and extent of consumption for the area as a whole. Land requirements for different types of farms vary greatly, but the land in farms is a measure which, together with prevailing types and sizes of farms, makes a comparison between different areas possible. In 1947, consumption of electricity amounted to 83 kilowatt-hours per acre of all land in farms (table 7). Consumption per acre of land in crops was 207 kw.-

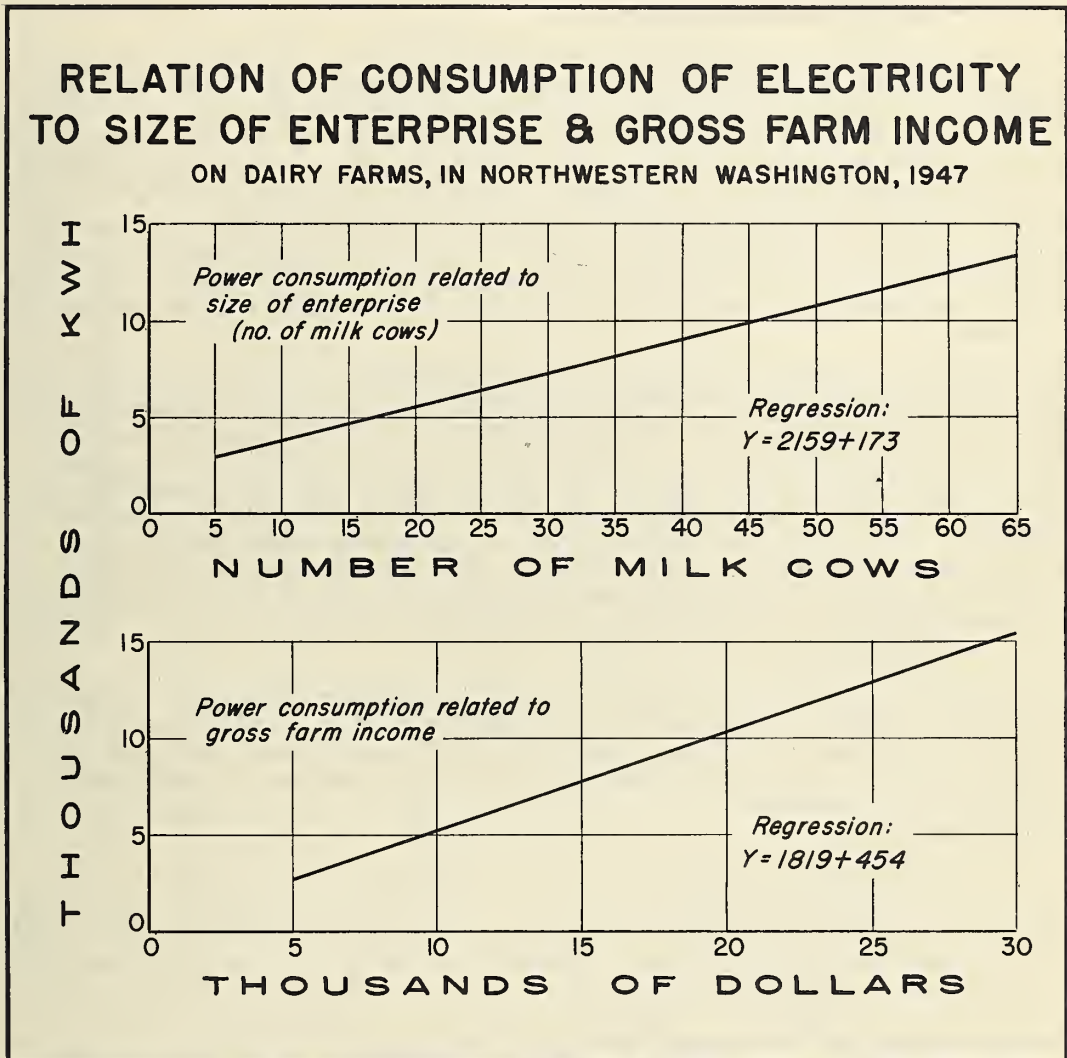
Table 7.-Weighted average consumption of electricity per acre of land by size and type of farm and economic land use, northwestern Washington, 1947.

Item	Consumption per acre		
	Cropland:	Cropland and: plowable pasture	Total land in farms
	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.
Size of farm			
Large . . . . .	135	94	74
Medium . . . . .	191	107	82
Small . . . . .	292	149	87
Type of farm			
Dairy . . . . .	214	108	74
Poultry . . . . .	1,230	500	255
Cash-crop . . . . .	75	59	53
Part-time . . . . .	318	166	84
Subsistence . . . . .	375	223	141
Land use			
Classes 1 and 2 . . . . .	142	97	83
Class 3 . . . . .	223	112	76
Classes 4 and 5 . . . . .	316	153	85
All farms . . . . .	207	120	83

hrs. and per acre of cropland and plowable pasture 120 kw.-hrs. In the better locations (land classes 1 and 2) consumption per acre of cropland was less than half that in less favorable locations. This difference is due primarily to the different types and sizes of farms that predominate on particular land classes. Lower land use areas have a higher proportion of poultry farms which not only have a relatively large use for electricity per farm, but which require only a small acreage of land. Furthermore, land classes 4 and 5 have a higher proportion of small, part-time, and subsistence farms which have

small acreages in relation to consumption of electricity. Differences in consumption per acre of cropland by land-class areas disappear or become irregular when consumption is related to all land in farms, because of the varying acreages of land included in farms but not cultivated or pastured. Generally, the proportion of this type of land increases as the resources become less productive.

On farms that are small in size of business or are of a type that uses less land than others, consumption of electricity per acre of cropland or per acre of all land in farms is higher than on farms large in size of business or in acreage. A certain minimum of electricity is used in the farm home regardless of the size of the farm business, and home use, generally speaking, constitutes a larger proportion of total use on small than on large farms. Thus, small farms of all types, as well as poultry, part-time, and subsistence farms, have a relatively high consumption of electricity per acre of land as compared with dairy and cash-crop farms.



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Figure 5. Consumption of electricity on dairy farms increased by about 865 kilowatt-hours with the addition of each 5 milk cows to the herd and by 900 kilowatt-hours with every increase of \$2,000 in gross farm income.

Use of electricity may also be related to specific enterprises on farms, particularly those for which opportunities to employ electricity are comparatively large. Dairy farms, because of their predominance in the area and because of the numerous opportunities to use electricity in dairy production, were chosen to illustrate the relation between size of enterprise and consumption of electricity.

In the top portion of figure 5, the relation between consumption of power and size of enterprise on dairy farms is illustrated graphically. On the average, for each 5 milk cows on dairy farms, consumption of power increased by 865 kilowatt-hours. The relation is fairly close, which is true primarily of farms with less than 25 cows rather than those with larger herds. This is because large farms frequently have supplementary enterprises, and this affects the relation of the size of the dairy enterprises alone to consumption of power. Furthermore, household use of electricity does not increase in direct proportion to an increase in the size of the dairy enterprise, although larger farms, chiefly because of higher incomes, have higher home use of electricity. On the other hand, household use of electricity on most farms exceeds farm use, and this makes the size of the predominant farm enterprise less suitable as an indicator of the level of total consumption of power.

The reason for a fairly satisfactory correlation between size of enterprise and consumption of power lies in the rather high correlation between size of enterprise and gross farm income and that between income and consumption of power. An increase in the size of the dairy enterprise by the addition of 5 cows resulted in an increase in gross farm income of somewhat over \$2,000. Higher income, on the other hand, was closely associated with greater use of electricity. This relationship is illustrated in the bottom part of figure 5. With every increase of \$2,000 in gross farm income, consumption of power rose by about 900 kilowatt-hours. In each case of correlating gross farm income to size of enterprise and consumption of power to farm income, the coefficient of correlation was higher than that for the relation between consumption of power and size of enterprise.

Because the purchase of electric appliances and their use involve capital outlay and current cash expenditures for operation and maintenance, the level of farm income is a major influence upon consumption of power. Information obtained as to farmers' incomes included only gross farm and off-farm incomes. Particularly, for an analysis of income in relation to home use of electricity, net income rather than gross income data would be more suitable and they would be more comparable with data showing income from off-farm sources. The latter are, in effect, net incomes available from these sources. If it can be assumed, however, that for a specific type of farm the amounts expended for feed, supplies, and similar items are in direct proportion to the gross farm income received, an analysis of gross farm income in relation to consumption of power is feasible by type of farm.

In general, on poultry farms that rely primarily upon purchased feeds, net income constitutes a smaller part of gross farm income than is true on cash-crop or dairy farms. For all commercial types of farms, income from off-farm sources was not considered in the analysis of the relation of income to consumption of power. But on part-time farms, on which off-farm income is of major importance, it was added to gross farm income.

Average gross farm and off-farm income in 1947, by size and type of farm and economic land use classes, is given in table 8. Gross farm income in 1947 on medium-sized farms of different types and on different land use classes was fairly stable except for that on poultry farms. The higher gross farm income for this type is probably more than offset by higher production expenditures, making net farm incomes of all types of farms more comparable. Average gross farm income for large and for small farms showed considerable variation between types of farms and land use classes. The major reason for this variation on large and small farms in comparison with that on medium-sized farms lies in the size classification, which delineates the upper and lower limits on medium-sized farms but does not define an upper limit on large or a lower limit on small farms.

Table 8.- Average gross farm and off-farm income, by size and type of farm and economic land use class, northwestern Washington, 1947. 1/

	Type of farm										Land use	
	Dairy	Poultry	Cash-crop	Part-time	Subsistence	Misc.	Classes 1 and 2	Class 3	Classes 4 and 5	All farms		
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars
Gross farm income												
Large	17,900	33,700	27,900	---	---	20,200	26,600	19,200	26,100	24,600		
Medium	8,700	11,200	8,600	---	---	8,000	8,800	8,400	8,200	8,500		
Small	3,600	5,200	4,400	1,500	1,300	4,500	4,100	3,700	3,400	3,700		
All	8,200	13,300	14,600	1,500	1,300	10,200	12,400	8,100	8,200	9,900		
Off-farm income												
Large	211	378	262	---	---	100	277	158	289	259		
Medium	328	303	715	---	---	567	351	302	543	393		
Small	667	386	955	2,936	733	2,183	1,141	1,125	1,101	1,118		
All	435	360	620	2,936	733	1,169	587	659	832	693		
Off-farm income per farm reporting												
Large	970	1,088	1,112	---	---	400	1,038	1,000	1,012	1,026		
Medium	1,575	1,300	1,431	---	---	850	1,245	1,210	1,992	1,450		
Small	1,913	1,016	1,458	3,007	1,100	3,175	1,973	2,126	2,202	2,111		
All	1,648	1,091	1,380	3,007	1,100	2,171	1,568	1,812	2,035	1,803		

1/ Data of income are not weighted by the proper representation of farms in the area but are averages for the sample.

Off-farm income is minor on all commercial types of farms except possibly on small farms. The proportion of farms reporting off-farm income and the percentage of the total income derived from off-farm sources in 1947 are given in table 9. A considerable number of commercial types of farms reported income from other than farm sources; this was particularly true of the small farms in poor locations. The amount of off-farm income received on commercial types of farms in percentages of the totals did not exceed 18 percent even for small farms. Part-time farms received two-thirds of their income from off-farm sources and subsistence farms somewhat more than one-third. Small farms on land classes 4 and 5 derived a higher proportion of their income from off-farm sources, although the number of small farms receiving off-farm income was greatest on land classes 1 and 2.

Table 9.- Proportion of farms reporting off-farm income and proportion of total income derived from off-farm sources, by type and size of farm and by economic land use class, northwestern Washington, 1947.

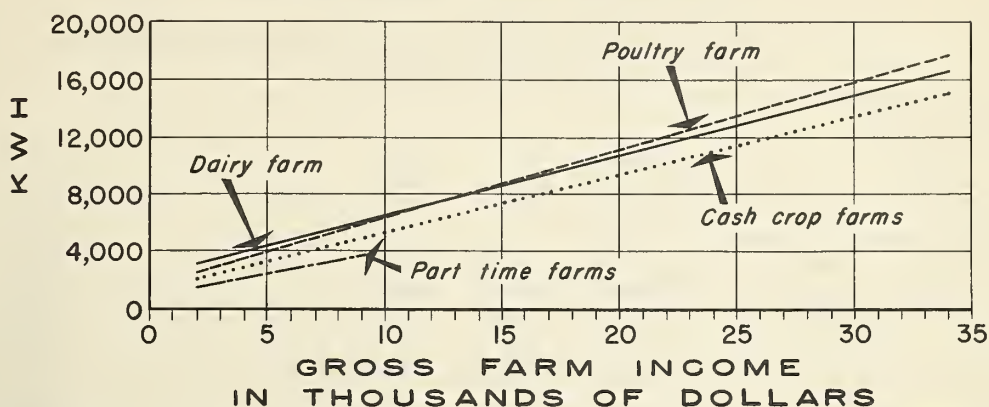
Item	: Percentage of all farms report- : : ing off-farm income : :				: Percentage of total income de- : : rived from off-farm sources : :			
	: Large	: Medium	: Small	: All	: Large	: Medium	: Small	: All
	: sizes	: sizes	: sizes	: sizes	: sizes	: sizes	: sizes	: sizes
	: Pct.	: Pct.	: Pct.	: Pct.	: Pct.	: Pct.	: Pct.	: Pct.
Type of farm								
Dairy . . . . .	21.7	20.8	40.4	28.6	1.2	4.1	15.7	5.1
Poultry . . . .	34.8	23.3	38.0	33.0	1.1	2.6	6.9	2.6
Cash-crop . . .	23.5	50.0	65.5	44.9	.9	7.7	17.7	4.1
Part-time . . .	---	---	97.6	97.6	---	---	65.8	65.8
Subsistence . .	---	---	66.7	66.7	---	---	35.5	35.5
Miscellaneous	25.0	66.7	66.7	53.8	.5	6.6	32.7	10.3
Land use classes								
1 and 2 . . . . .	26.7	28.2	65.6	40.0	1.1	3.8	21.8	4.5
3 . . . . .	15.8	25.0	52.9	36.4	.8	3.5	23.2	7.5
4 and 5 . . . . .	28.6	27.3	50.0	40.9	1.1	6.2	24.2	9.2
All farms . . . .	25.2	27.1	55.3	39.5	1.0	4.4	23.2	6.5

The relation of the consumption of electricity to gross farm income by major types of farms is presented in figure 6 and table 56, page 92. The nature of the available data and the influence of factors other than income result in a coefficient of correlation between consumption of power and income which indicates a fair relationship on the major commercial types of farms. On part-time farms the relationship is of little significance.

In general, on poultry farms the consumption of power increases more rapidly with an increase in income than on other types of farms (fig. 6). The tendency to use more electric farm appliances as income and size of enterprise increase is greater than appears to be the case on cash-crop farms. On the latter type, increased home consumption of electricity rather than more extensive use of electricity on the farm results in a somewhat lower rate of expansion in consumption as income increases. Only a few of the very large cash-crop farms have a sufficient volume of production to do their own sorting, packing, and storing of commodities, for which electricity could be used extensively. On dairy farms, the rate of increase in consumption of power amounts to 425 kilowatt-hours per \$1,000 of gross farm income, and consumption is comparatively high even at a low income.

## RELATION OF CONSUMPTION OF ELECTRICITY TO FARM INCOME, BY TYPE OF FARM

NORTHWESTERN WASHINGTON, 1947



Regression: Dairy farms,  $Y = 2132 + .4245X$

Poultry farms,  $Y = 1668 + .4732X$

Cash crop farms,  $Y = 1394 + .4046X$

Part time farms,  $Y = 751 + .3392X$

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Figure 6. Although an increase in consumption of electricity associated with an increase in gross farm income was greater on poultry farms than on other types of farms, the difference is not of major significance.

### Major Electric Home and Farm Appliances in Use in 1947

Home and farm appliances of many kinds were found in use on farms but only a relatively few are used frequently enough or over a long enough period to require a large amount of electricity per year. The major electric appliances used in farm homes are ranges, refrigerators, and water heaters. In the farm business, the use of electric appliances varies primarily with the type of farm. For purposes of comparison between types of farms and as an indication of the extent and possibility of the use of electricity in the farm business, the proportions of farms reporting two important farm buildings connected with electricity, as well as reporting two of the more common farm appliances, are given here for the area as a whole.

Among the major home appliances, refrigerators are more commonly in use than electric ranges or water heaters (table 10). Of all farms in the area 83 percent reported refrigerators, whereas less than 33 percent reported ranges or water heaters. Generally speaking, the density of these appliances was greater on cash-crop and dairy farms than on other types. The percentage of farms reporting home appliances declined more sharply in the case of ranges and water heaters as the size of farm declined than was true for refrigerators. Proportionately fewer appliances, generally speaking, are reported on farms that had low productive resources than on farms on better classes of land. Differences between land classes are more often the result of variations among types and sizes predominating on specific land use classes.

Refrigerators had generally been installed and connected at an earlier date than electric ranges and water heaters. Approximately 70 percent of the refrigerators for which the date of connection was reported were connected before 1945 (table 57, page 93). Of the electric ranges, 52 percent were connected before that year but only 37

Table 10.- Percentage of farms reporting major home appliances weighted by the distribution of farms as to type and size of farm and economic land use class, northwestern Washington, 1947.

Item	Dairy	Poultry	Cash-crop	Part-time	Subsistence	All farms
	Percent	Percent	Percent	Percent	Percent	Percent
<b>Electric Range</b>						
Size of farm						
Large . . . . .	66.5	54.4	83.3	---	---	71.1
Medium . . . . .	43.9	27.3	40.0	---	---	41.0
Small . . . . .	24.3	25.5	37.6	19.2	31.5	23.6
Land use						
Classes 1 and 2 . . .	46.0	---	60.2	37.5	---	47.0
Class 3 . . . . .	30.6	34.3	50.0	---	---	22.8
Classes 4 and 5 . . .	27.6	38.0	---	19.2	31.5	26.6
All farms . . . . .	33.9	33.1	59.5	19.2	31.5	31.4
<b>Refrigerator</b>						
Size of farm						
Large . . . . .	93.0	90.9	91.7	---	---	92.1
Medium . . . . .	88.7	62.2	90.0	---	---	85.1
Small . . . . .	89.2	52.3	87.6	81.1	63.1	80.8
Land use						
Classes 1 and 2 . . .	84.1	---	89.6	100.0	---	85.7
Class 3 . . . . .	84.0	81.2	100.0	100.0	---	85.7
Classes 4 and 5 . . .	95.3	73.2	---	73.1	63.1	80.4
All farms . . . . .	89.3	65.5	90.3	81.1	63.1	82.7
<b>Water Heater</b>						
Size of farm						
Large . . . . .	65.4	54.4	70.8	---	---	65.6
Medium . . . . .	43.3	31.8	45.0	---	---	41.9
Small . . . . .	30.1	25.5	28.3	20.2	31.5	26.1
Land use						
Classes 1 and 2 . . .	41.1	---	54.0	37.5	---	42.8
Class 3 . . . . .	44.6	40.8	50.0	25.0	---	38.3
Classes 4 and 5 . . .	31.0	39.4	---	15.4	31.5	26.6
All farms . . . . .	37.2	34.9	53.7	20.2	31.5	32.8

percent of the water heaters. These three major home appliances were bought earlier on large farms than on medium-sized or small farms. Furthermore, a remarkably large number of appliances were connected during the war and postwar years when farm income was at a high level.

The use of farm appliances depends primarily upon the type and size of farming operations. Only farms having sizable dairy enterprises would have milk houses and use milking machines. Dairy enterprises of this kind, however, are not limited to farms classified as dairy farms. Cash-crop farms with relatively large dairy enterprises are rather common.

Table 11.- Percentage of farms reporting specified farm buildings connected and major farm appliances weighted by the distribution of farms as to type and size of farm and economic land use class, northwestern Washington, 1947.

Item	Dairy	Poultry	Cash-crop	Part-time	Subsistence	All types
	Percent	Percent	Percent	Percent	Percent	Percent
Milk house wired						
Size of farm						
Large . . . . .	85.5	8.9	54.2	---	---	59.3
Medium . . . . .	87.4	34.9	65.0	---	---	76.8
Small . . . . .	67.6	11.3	50.2	37.4	33.3	48.2
Land use						
Classes 1 and 2 . . .	87.0	83.3	55.9	62.5	---	74.2
Class 3 . . . . .	86.4	29.8	75.0	62.5	---	76.9
Classes 4 and 5 . . .	62.2	9.2	---	26.9	33.3	39.8
All farms . . . . .	75.2	20.4	57.3	37.4	33.3	55.0
Poultry-laying house wired						
Size of farm						
Large . . . . .	32.7	68.0	41.7	---	---	42.6
Medium . . . . .	41.9	92.1	30.0	---	---	47.3
Small . . . . .	43.6	97.3	53.1	64.7	66.7	57.5
Land use						
Classes 1 and 2 . . .	39.8	100.0	38.9	75.0	---	47.2
Class 3 . . . . .	25.7	100.0	50.0	50.0	---	36.6
Classes 4 and 5 . . .	51.7	84.6	---	65.4	66.7	62.5
All farms . . . . .	42.2	88.3	39.7	64.7	66.7	54.1
Electric milking machines used						
Size of farm						
Large . . . . .	97.8	22.6	54.2	---	---	66.8
Medium . . . . .	87.8	24.2	60.0	---	---	74.9
Small . . . . .	76.2	13.5	24.8	35.5	0.0	45.7
Land use						
Classes 1 and 2 . . .	88.9	33.3	54.6	50.0	---	71.3
Class 3 . . . . .	90.8	41.3	0.0	62.5	---	77.7
Classes 4 and 5 . . .	72.4	14.7	---	26.9	0.0	38.4
All farms . . . . .	81.6	20.1	50.7	35.5	0.0	53.5
Water heater used <sup>1/</sup>						
Size of farm						
Large . . . . .	86.6	8.9	45.8	---	---	56.3
Medium . . . . .	77.6	14.9	55.0	---	---	65.6
Small . . . . .	47.1	2.7	12.4	3.7	0.0	20.6
Land use						
Classes 1 and 2 . . .	72.0	16.7	46.1	12.5	---	53.3
Class 3 . . . . .	74.7	34.8	0.0	12.5	---	53.9
Classes 4 and 5 . . .	44.9	4.1	---	0.0	0.0	17.4
All farms . . . . .	59.9	9.2	42.8	3.7	0.0	32.9

<sup>1/</sup> For use in farm business only.

The proportion of farms reporting wired milk houses and poultry-laying houses (table 11) indicated the extent to which these facilities were available on farms in the area. It also points out on what types and sizes more specialized appliances for the particular enterprise may be found. For the area as a whole, 55 percent of all farms reported wired milk houses and 54 percent reported wired poultry-laying houses. Three-fourths of the dairy farms and 57 percent of the cash-crop farms had electric connections in milk houses. Of the poultry farms in the area, 88 percent reported wired laying houses. The proportion increased as the size of farm decreased, because the poultry enterprise on many large poultry farms was devoted to production of poultry meat rather than to production of eggs.

Electric milking machines were found on about 54 percent of the farms in the area. They were used on dairy farms, and particularly on the large farms and, in considerable numbers, on cash-crop farms, where a proportionately greater number was in use on farms of medium size. About a third of all farms in the area had water heaters for farm use only. A number of water heaters, generally the larger sizes and listed under home appliances, were also used in the farm business. But when the need for hot water on the farm was great, a second water heater was usually reported under farm appliances. Frequently, an electric water heater was used and the need for hot water in the dwelling was filled by heating water through coils in an oil or wood range and storing it in a separate tank in the farm house. Water heaters on the farm were used primarily in connection with dairy enterprises. Only a few poultry farms specializing in meat production employed them in preparing dressed poultry for nearby markets on a year-round basis.

The date of connection with electricity of special farm buildings (table 58, page 94) was at the time or shortly after electricity had become available on the farm. More than half of all milk houses and poultry-laying houses were connected before 1935. Milking machines and water heaters, however, were installed primarily during the period 1940-44. Again, large farms showed a higher proportion of these appliances connected at an early date than did medium-sized or small farms.

Farm buildings or electric appliances other than those shown above are generally identified with one specific type of farm. They are discussed separately for each of the major types represented in the area. Then there remains the use of electricity in motors to operate miscellaneous tools or appliances.

All electric motors for which two or more uses were reported and which were not a permanent part of a specific appliance were listed separately. They were used for miscellaneous farm jobs, principally on the tool grinder and other appliances in the workshop, and on feed grinders, choppers, elevators, etc. Generally speaking, these motors are small and of the portable type.

Of the major types of farms, multiple-purpose motors were more numerous on poultry farms (table 12). For this type, not only the largest number of farms reported electric motors, but also a proportionately large number of farms had more than one motor in use. Cash-crop farms, however, had the highest average number of motors per farm reporting multiple-purpose motors. On poultry farms, a larger percentage of the motors were stationary while on dairy and cash-crop farms, from two-thirds to three-fourths of the multiple-purpose motors were portable. Large farms reported proportionately more motors than medium-sized or small farms, but the average number of motors reported per farm and the proportion of portable types did not vary appreciably between sizes of farms. Of all multiple-purpose motors on farms, 68 percent were portable; the remainder were stationary or mounted permanently for multiple use.

Most of the multiple-purpose motors (82 percent) were small; that is, less than 1 horsepower (table 13). Motors of 1 to 3 horsepower comprised 15 percent of the total and those exceeding 3 horsepower, 3 percent. A slightly larger proportion of the stationary motors were over 1 horsepower in size and the average cost of these was generally higher than that of portable motors of comparable sizes.

Table 12.- Proportion of farms reporting multiple-purpose motors, average number of motors per 100 farms, and proportion of motors of portable type, by size and type of farm, northwestern Washington, 1947.

Item	Proportion of farms reporting		Motors per 100 farms	Proportion of motors of portable type
	Motors	More than one motor		
Size of farm				
Large . . . . .	38.3	11.2	51	63.6
Medium . . . . .	30.3	7.7	39	70.5
Small . . . . .	21.0	5.5	28	69.4
Type of farm				
Dairy . . . . .	21.6	4.3	26	73.3
Poultry . . . . .	46.6	16.5	67	59.4
Cash-crop . . . . .	24.7	9.0	38	67.6
Part-time . . . . .	19.0	---	19	87.5
Subsistence . . . . .	33.3	---	33	100.0
Miscellaneous . . . . .	38.4	7.7	46	83.3
All farms . . . . .	27.9	7.5	37	68.4

Table 13.- Number and average cost of multiple-purpose motors on farms, by type and size of motor, northwestern Washington, 1947.

Size of motor	Portable			Stationary		
	Quantity		Average cost	Quantity		Average cost
	Actual	Percentage of total		Actual	Percentage of total	
	Number	Percent	Dollars	Number	Percent	Dollars
1/4 HP or less . . . . .	31	29.8	22	22	45.8	21
1/3 HP . . . . .	30	28.9	29	6	12.5	29
1/2 HP . . . . .	20	19.2	39	7	14.6	29
2/3 - 3/4 HP . . . . .	7	6.7	31	1	2.1	50
1 - 1-1/2 HP . . . . .	8	7.7	60	5	10.4	90
2 - 3 HP . . . . .	5	4.8	118	5	10.4	136
4 - 5 HP . . . . .	1	1.0	100	1	2.1	200
6 HP and over . . . . .	2	1.9	295	1	2.1	1,000
Total . . . . .	104	100.0	42	48	100.0	67



Figure 7. Electricity in the farm home greatly lightens the work of the housewife and the family.

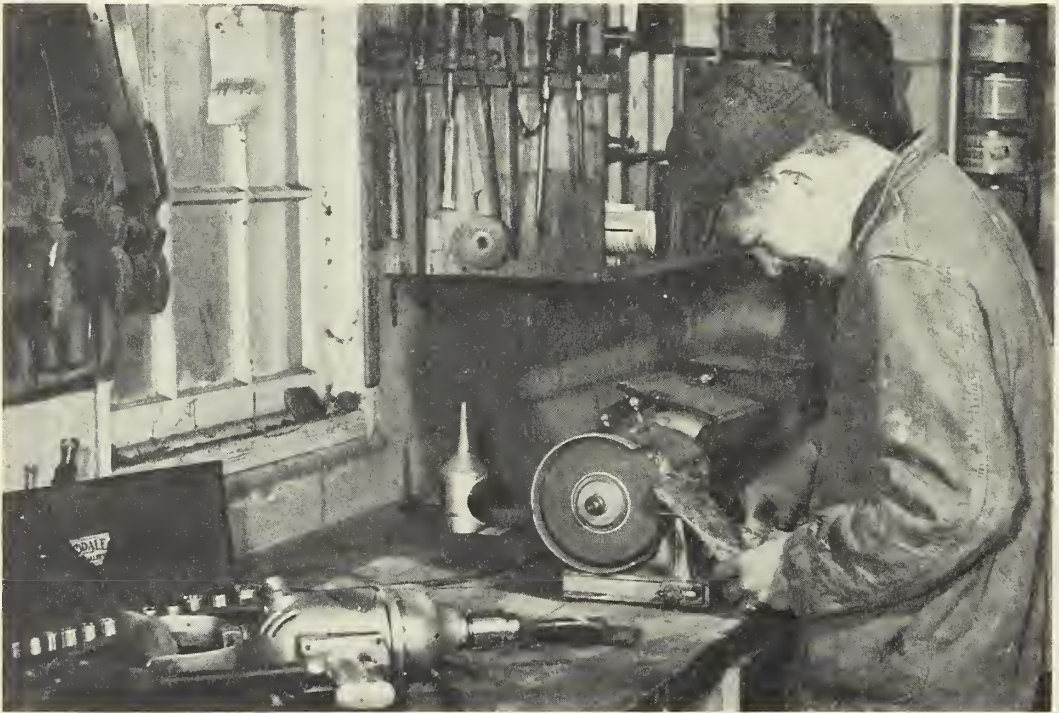


Figure 8. In modern farm shops electricity is a great convenience. Many shop appliances make hard work easy.

### Competitive Sources of Energy

Other sources of energy offer comparatively little competition with electricity for some uses. For other uses existing conditions favor nonelectric appliances. In the case of essential uses the availability of electric appliances, as ranges, indicates at the same time to what extent nonelectric appliances are available. For other appliances, as refrigerators or deep freezers, the availability of electric appliances practically indicates to what extent refrigeration is available in the homes. On the farms, the use of electric appliances seldom indicates the extent of use of other sources of energy.

Table 14.- Proportion of farms reporting nonelectric appliances for use in the home and on the farm by size and type of farm, northwestern Washington, 1947.

Item	Percentage of all farms							
	Size				Type			
	Large	Medium	Small	All	Dairy	Poul-try	Cash-crop	Part-time
	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent
Farm home								
Ranges, oil . . . . .	17.8	20.0	17.8	18.5	17.7	16.5	21.3	19.0
wood . . . . .	20.6	25.8	37.4	29.9	26.8	36.9	27.0	38.1
other . . . . .	11.2	14.2	18.7	15.6	19.0	12.6	5.6	23.8
Refrigerators . . . . .	.0	3.9	2.3	2.3	3.5	.0	1.1	4.8
Water heaters . . . . .	20.6	31.0	37.0	31.4	37.7	22.3	23.6	38.0
Farm business								
Brooders . . . . .	11.2	13.5	16.0	13.1	3.9	41.7	4.5	16.7
City water supply . . . . .	54.2	53.5	43.8	49.3	47.6	38.8	75.3	28.6
Milk coolers . . . . .	46.7	59.4	39.7	47.6	77.1	13.6	30.3	23.8
Milking machines . . . . .	---	---	.5	.2	.4	---	---	---
Stationary engines . . . . .	11.2	4.5	2.7	5.2	6.9	2.9	3.4	4.8
Water systems								
operated by other								
than electric								
power . . . . .	8.4	5.8	5.9	6.4	6.1	7.8	5.6	2.4

In table 14 is given the proportion of farms reporting sources of energy other than electricity for major uses in the homes and on the farms. Almost two-thirds of all farms reported other than electric ranges in farm houses. Some of these were used in addition to electric ranges; others were the only kind of range used. After electric ranges, wood ranges were most frequently reported. Most of these have coils for heating water which is stored in a nearby tank. Therefore, a considerable number of farms reported water heaters that were not electric. In general, the number of farms reporting sources of energy other than electricity was proportionately greater for small than for large farms.

With regard to farm appliances, many farms reported the use of brooders heated by other means. This is particularly true of specialized poultry farms where, in many cases, oil or other fuels are preferred. Some poultrymen spoke of the higher death losses of chicks, with electric brooders; and of higher labor costs because of the necessity of changing the litter more frequently.

The situation with regard to water supply is one of the influences in the competitive situation between electricity and other sources of energy. In much of the area, the quality of water obtained from wells is not satisfactory. This is typical in many low-lying localities that are close to the coast which have a relatively high water table. The density of farms and their location near population centers have further encouraged the connection of farms to nearby city water systems. Almost half of all farms reported the availability of city water. However, as the costs of city water are comparatively high and as only shallow wells are needed to obtain water for all uses for which quality is less important, city water is used primarily for domestic purposes and well water is used on the farms. Although the water-pressure systems are operated chiefly with electricity, the cooling of milk in this predominantly dairy area is done primarily by water coolers. Only 15 electric milk coolers as against 231 water coolers were reported.

In most cases the number or proportion of farms reporting certain appliances does not indicate the extent of use of competitive sources of energy as some farms have none of the appliances and other farms have several appliances of the same type. Therefore, the number and proportion of major home and farm appliances operated by electricity and other sources of energy are presented in table 15. Of all ranges in use on farms, approximately 40 percent were electric ranges, larger farms having a higher proportion of these. Practically all refrigerators were electrically operated. Of the water heaters in use, the majority were operated by electricity. But dairy farms had a lower than average proportion of electric water heaters, apparently mainly because of the relatively large number of small dairy farms that heat water in connection with wood or oil ranges.

In the farm business, the use of electric appliances predominated. Two-thirds of the brooders were operated by electricity, but poultry farms reported a lower-than-average percentage. Only a few electric milk coolers, primarily on large dairy farms, were reported; water coolers were more commonly used. All milking machines were electric and of the multiple-use motors of 1 horsepower and above, more than half were electric. Gasoline motors, however, usually were considerably larger, as expressed in belt horsepower, than electric motors. Water systems, consisting chiefly of pressure systems, were usually operated by electricity.

#### Seasonal Variation in Consumption of Electricity, 1941 and 1947

Consumption of electricity varies considerably, not only during the day and for each day of the week, but also during the particular time of the year. It was not feasible in this study to ascertain the daily variations in consumption, but data showing the monthly use of electricity on farms were more readily available and could be analyzed for a prewar and a postwar year.

The determination of the seasonal pattern of consumption on farms and the comparison between 1941 and 1947 lag somewhat in accuracy because in an area covering a large number of routes, meters are read on different days of the month. Furthermore, the voluntary continuation of the wartime measure of reading meters every second month, rather than monthly, adds to the difficulty of making comparisons. As a result of bimonthly readings, in which the reported consumption of individual consumers on different routes does not cover identical months, the seasonal pattern for 1947 appears to be smoother than is actually the case.

The weighted average monthly consumption of electricity on farms in northwestern Washington, in 1941 and 1947, as given in table 59 (page 95 ) by size of farm, indicates that actual consumption, except that of large farms, is highest in December. This does not appear to be realistic as a comparison with other months of the year cannot be made without adjusting for the increase in consumption during the year. For example, an average consumption on all farms in December 1947 of 415 kilowatt-hours exceeded

Table 15.- Number and proportion of major home and farm appliances, by source of energy and by size and type of farm, northwestern Washington, 1947.

Item	Size of farm						Type of farm						Total			
	Large		Medium		Small		Dairy		Poultry		Cash-crop		Part-time		All farms	
	Per- cent- : tity : total	Quant- : tity : total	Per- cent- : tity : total	Quant- : tity : total	Per- cent- : tity : total	Quant- : tity : total	Per- cent- : tity : total	Quant- : tity : total	Per- cent- : tity : total	Quant- : tity : total	Per- cent- : tity : total	Quant- : tity : total	Per- cent- : tity : total	Quant- : tity : total	Per- cent- : tity : total	Quant- : tity : total
Farm home																
Range																
Electric	76	55.1	73	43.2	60	26.8	104	40.5	40	36.1	51	50.5	8	18.6	209	39.4
Oil	21	15.2	32	18.9	40	17.9	42	16.3	19	17.1	19	18.8	8	18.6	93	17.5
Wood	25	18.1	40	23.7	83	37.0	64	24.9	39	35.1	24	23.8	17	39.5	148	27.9
Other	16	11.6	24	14.2	41	18.3	47	18.3	13	11.7	7	6.9	10	23.3	81	15.2
Total	138	100.0	169	100.0	224	100.0	257	100.0	111	100.0	101	100.0	43	100.0	531	100.0
Refrigerator																
Electric	117	100.0	133	95.7	167	97.1	203	96.2	83	100.0	83	98.8	33	94.3	417	97.4
Nonelectric	---	---	6	4.3	5	2.9	8	3.8	---	---	1	1.2	2	5.7	11	2.6
Total	117	100.0	139	100.0	172	100.0	211	100.0	83	100.0	84	100.0	35	100.0	428	100.0
Water heater																
Electric	80	77.7	70	58.3	60	42.6	103	53.4	41	64.1	46	68.7	9	36.0	210	57.7
Nonelectric	23	22.3	50	41.7	81	57.4	90	46.6	23	35.9	21	31.3	16	64.0	154	42.3
Total	103	100.0	120	100.0	141	100.0	193	100.0	64	100.0	67	100.0	25	100.0	364	100.0
Farm business																
Brooders																
Electric	23	67.6	37	62.7	58	65.9	31	79.5	66	62.3	9	69.2	7	53.8	118	65.2
Nonelectric	11	32.4	22	37.3	30	34.1	8	20.5	40	37.7	4	30.8	6	46.2	63	34.8
Total	34	100.0	59	100.0	88	100.0	39	100.0	106	100.0	13	100.0	13	100.0	181	100.0
Milk coolers																
Electric	10	16.1	4	4.2	1	1.1	9	4.8	1	6.7	3	10.0	---	---	15	6.1
Nonelectric	52	83.9	92	95.8	87	98.9	178	95.2	14	93.3	27	90.0	10	100.0	231	93.9
Total	62	100.0	96	100.0	88	100.0	187	100.0	15	100.0	30	100.0	10	100.0	246	100.0
Milking machines																
Electric	70	100.0	110	100.0	107	99.1	201	99.5	20	100.0	38	100.0	16	100.0	287	99.7
Nonelectric	---	---	---	---	1	.9	1	.5	---	---	---	---	---	---	1	.3
Total	70	100.0	110	100.0	108	100.0	202	100.0	20	100.0	38	100.0	16	100.0	288	100.0
Motor (1 HP and over)																
Electric	22	56.4	8	50.0	6	50.0	17	45.9	4	57.1	13	72.2	---	---	36	53.7
Nonelectric	17	43.6	8	50.0	6	50.0	20	54.1	3	42.9	5	27.8	2	100.0	31	46.3
Total	39	100.0	16	100.0	12	100.0	37	100.0	7	100.0	18	100.0	2	100.0	67	100.0
Water system																
Electric	84	90.3	108	92.3	172	93.0	175	92.6	90	91.8	56	91.8	31	96.9	364	92.2
Nonelectric	9	9.7	9	7.7	13	7.0	14	7.4	8	8.2	5	8.2	1	3.1	31	7.8
Total	93	100.0	117	100.0	185	100.0	189	100.0	98	100.0	61	100.0	32	100.0	395	100.0

that in January 1947 by 45 kw.-hrs., or 12 percent, but probably did not exceed average consumption during the succeeding month--January 1948. Appliances first connected in 1947 were in use in December of that year and during the succeeding year but not in January 1947. Increase during any one year might be disregarded in a comparison between the seasonal patterns of two individual years if it were sound to assume that during these years it was of the same magnitude and at the same rate. But this is not the case. The increase in consumption of power during 1947 was considerably greater than that in 1941. Thus it was necessary to adjust monthly data for increase during the year.

Seasonal distribution of consumption of power by size of farm, corrected for increase during the year, is shown in figure 9 for the years 1941 and 1947. Adjusted monthly consumption is expressed in percentage of the average consumption during the year. On an adjusted basis, consumption in January, except in two cases, exceeds that in December. Although the seasonal pattern of consumption in 1947 appears to be smoother, some significant changes are noticeable. In 1941, consumption in October was at or near the low point for the fall months. In 1947, September was the low point for that period of the year for all three size groups. A considerable variation between size groups is shown in the first half of the year. On large farms, consumption is comparatively high from January to July. On medium-sized farms consumption declined rapidly during this period and in March 1941 consumption on small farms was almost comparable to that in June and July. Thus, the period of relatively low consumption during the year shifted from the fall months on large farms to the summer months on medium-sized farms and to the spring or early summer months on small farms. On large farms the difference between the seasonal patterns in 1941 and 1947 was not significant, but on medium-sized and small farms the seasonal pattern in 1947 tended to level off. That is, during the months of relatively high consumption, the consumption was lower in 1947 than in 1941, while for periods of relatively low consumption, the 1947 data indicate a relatively higher consumption.

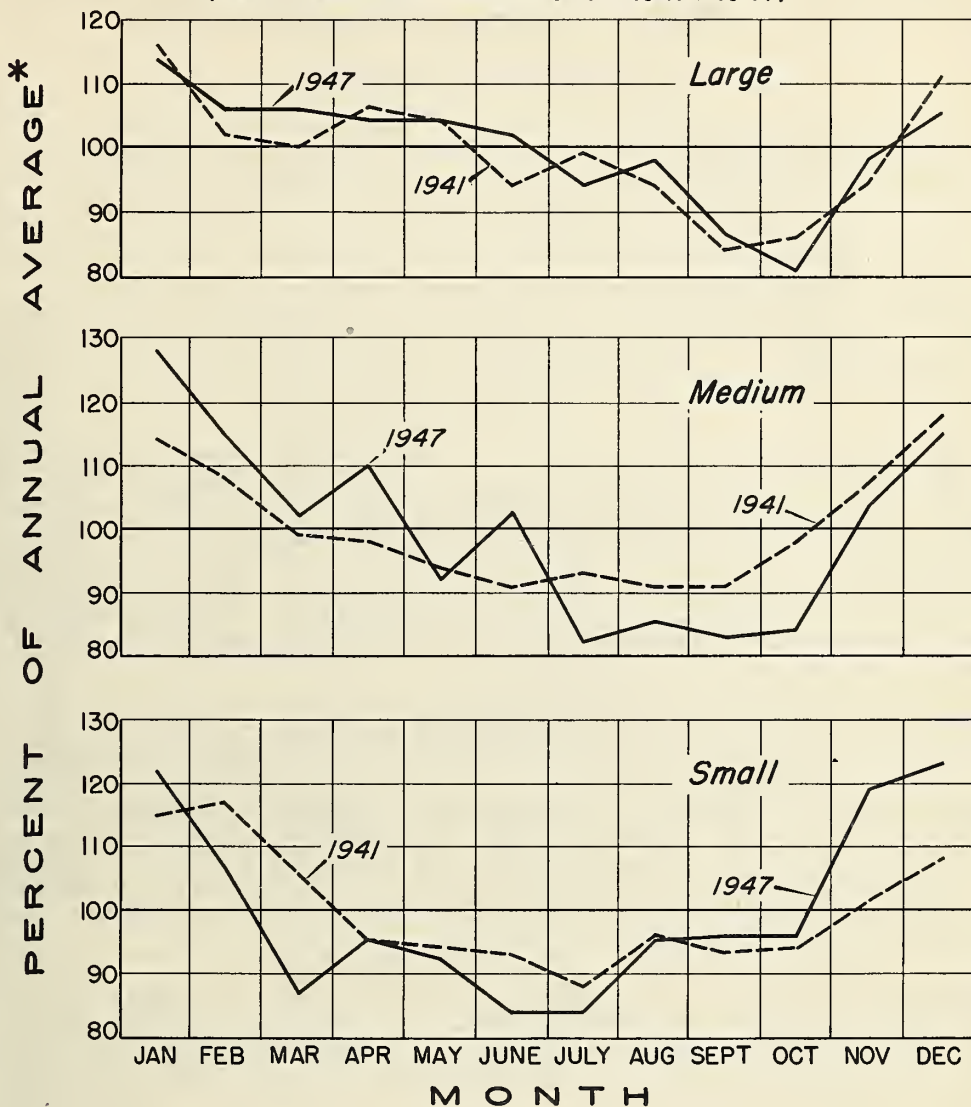
Differences in the seasonal pattern between major size groups may be traced in part to the differences in home and farm consumption. On large farms, farm consumption is relatively more important and it influences the seasonal pattern to a greater extent than does consumption in the home. As the size of farm declines, home consumption becomes more influential in determining the seasonal pattern, until in the small-farm group, where only minor amounts of electricity are used on the farms, the lighting of the dwelling constitutes the primary individual use influencing the seasonal pattern.

However, use of electricity for lighting in the home and on the farm, even on large farms, influences the seasonal pattern of consumption. Less daylight during the winter increases the use of electricity for lighting in the farm homes, but it also increases the lighting load on the farms in an area where lighting poultry houses to increase production is common.

Seasonal distribution of consumption of electricity by types of farms for 1941 and 1947 is illustrated in figure 10. In 1941 seasonal variations in consumption between dairy, cash-crop, and part-time farms were of minor significance. Poultry farms indicate extreme variations during that year. In 1947 seasonal variations on poultry farms were less drastic, but other types of farms showed a somewhat greater variation than in 1941. The addition of only a few poultry appliances on part-time farms raised consumption during the first 3 months of 1947. Dairy and cash-crop farms showed a relatively greater consumption of electricity during the summer months due primarily to increasing use of power for sprinkler irrigation. Seasonal distribution of consumption of electricity is discussed more fully in later sections for each type of farm separately.

# SEASONAL VARIATION IN CONSUMPTION OF ELECTRICITY BY SIZE OF FARM

(NORTHWESTERN WASHINGTON 1941 & 1947)



\* MONTHLY CONSUMPTION CORRECTED FOR GROWTH DURING THE YEAR  
AVERAGE FOR THE YEAR EQUALS 100

Figure 9. The low point in consumption in both years shifted from the second to the first 6 months of the year as the size of farm declined. This appears to be influenced by the proportions of farms of different types and land classes found in the area and represented in the three size groups.

In an area such as the Northwest, where the demand for electric energy seriously threatens to exceed the supply, even though measures are taken to modify peak loads, it appears desirable to investigate possible adjustments in seasonal and daily use of electricity on farms that will satisfy the demand for power without lowering voltage during critical hours or days. On the other hand, the economic use of generating facilities that produce power at dams requires that the use of electricity on farms during the off-season be encouraged whenever it is economically feasible. A factor in this connection is the increased use of electricity for sprinkler irrigation.

### Average Cost of Electricity

During the 10-year period 1938-47, farmers experienced three reductions in the most commonly used schedule of rates--the schedule for farm and residential use of electricity. These reductions, however, were more than offset by increased consumption, resulting in an increase in the annual expenditures for electricity. Generally speaking, annual expenditures increased most for consumers who, in 1938, had attained a level of consumption which gave them comparatively low rates. These users increased their consumption most in absolute terms so reductions in rates did not materially reduce their costs. Their expenditures increased almost in direct proportion to their increase in consumption. Small consumers benefited most through rate reductions during the 10-year period; through increased use they obtained rates in 1947 which were considerably below those they paid in 1948.

Rates charged for successive blocks of electricity and the amount used each month during the year combine to give the annual cost of electricity. Three main rate schedules--the farm and residential schedule, the water heating schedule, and the so-called "all electric" schedule--applied to most farms. The majority of farms were on the farm and residential schedule. When water was heated by electricity, the schedule for water heating, in effect, was in addition to the residential schedule. On a relatively small number of farms, the "all electric" rate schedule applied. This schedule is used when no other fuels are used and when cooking, water heating, and refrigeration, in addition to lighting, are done by electricity.

Changes in the residential schedule between 1938 and 1947, which involved both a change in the rates themselves and the intervals of monthly consumption to which different rates applied <sup>7/</sup>, have benefited small consumers proportionately more than large consumers. For example, in 1938 a small consumer using an average of 250 kilowatt-hours per month would have paid \$7.10. In 1947, he paid \$5.72--a reduction of 19 percent. In 1938, a large consumer who used an average of 880 kilowatt-hours per month paid \$13.40, and in 1947, \$12.52--a reduction of only about 7 percent. However, in 1947, the small consumer paid 2.3 cents per kw.-hr. used; the large consumer paid 1.4 cents, or 39 percent less.

Practically all farmers increased their consumption during the period 1938-47 and comparisons on the basis of identical monthly consumption at the beginning and end of the 10-year period are not realistic. Nevertheless, savings due to changes in rates have been greater on small farms than on large ones. Savings in monthly expenditures for increasing consumption are shown in the upper portion of figure 11 and in table 60, page 96. This illustration also shows the average monthly bills for consumers using the "all electric" rate schedule. This schedule, which has a relatively high minimum

<sup>7/</sup> Farm and residential rate schedules for 1938 and 1947 were as follows:

<u>1938</u>	
5¢ per kw.-hr. for the first 40 kw.-hrs.	3.2¢ per kw.-hr. for the first 60 kw.-hrs.
3¢ per kw.-hr. for the next 100 kw.-hrs.	2¢ per kw.-hr. for the next 240 kw.-hrs.
2¢ per kw.-hr. for the next 100 kw.-hrs.	1¢ per kw.-hr. for over 300 kw.-hrs.
1¢ per kw.-hr. for over 240 kw.-hrs.	:
Minimum bill \$1.00.	

Table 16.- Weighted average annual cost of electricity on farms, by size and type of farm, and economic land use class, northwestern Washington, 1947.

Item	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	Increase 1947 over 1938	
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Actual	Percent- age
Size of farm												
Large	73.83	76.85	78.98	80.47	89.56	98.44	95.78	109.49	114.21	132.55	58.72	80
Medium	38.42	39.56	41.21	43.33	50.15	54.81	56.04	63.24	71.13	80.57	42.15	110
Small	29.46	29.71	27.25	26.94	31.16	35.46	33.27	38.92	45.04	52.17	22.71	77
Type of farm												
Dairy	33.15	33.58	33.34	34.49	39.14	42.81	45.02	52.83	58.95	69.45	36.30	110
Poultry	51.30	54.14	51.84	52.58	61.68	75.28	68.63	81.22	89.81	108.99	57.69	112
Cash-crop	58.16	62.18	62.16	62.02	69.98	74.27	71.16	76.72	81.09	87.10	28.94	50
Part-time	26.31	25.92	23.53	23.45	27.48	31.37	30.50	34.64	38.33	42.74	16.43	62
Subsistence	42.20	43.00	40.41	38.33	44.46	51.38	35.02	40.72	55.98	62.91	20.71	49
Land use												
Classes 1 and 2	47.94	48.42	48.67	51.36	57.16	59.67	61.32	68.20	75.48	85.14	37.20	78
Class 3	35.20	36.90	36.21	34.61	39.86	43.54	43.75	51.74	56.27	63.29	28.09	80
Classes 4 and 5	29.45	29.94	27.88	27.67	32.54	38.72	35.17	41.42	47.84	56.41	26.96	92
All farms in area	35.30	35.98	34.76	35.11	40.29	45.08	43.54	50.23	56.58	65.19	29.89	85
State of Washington <sup>1</sup> / <sub>1</sub>	<sup>2</sup> / <sub>2</sub>	<sup>2</sup> / <sub>2</sub>	35	35	38	41	43	47	50	55	20 <sup>3</sup> / <sub>3</sub>	57 <sup>3</sup> / <sub>3</sub>
United States <sup>1</sup> / <sub>1</sub>	35	36	37	37	38	39	40	42	43	44	9	26

<sup>1</sup>/ All residential users, computed from data in Edison Electric Institute, Statistical Bulletin, 1938-47.

<sup>2</sup>/ Not available.

<sup>3</sup>/ Increase 1947 over 1940.

charge of \$4.50 up to 270 kilowatt-hours consumption, results in lower costs when the average monthly consumption is above 190 kw.-hrs. Above a consumption of 270 kw.-hrs. and up to 1,000 kw.-hrs. per month, the schedule specifies a charge of 0.7 cents per kw.-hr. For each kilowatt-hour above 1,000, a charge of 1 cent is made. The water-heating rate schedule is used in combination with the residential schedule and may involve considerations additional to those mentioned, such as the time of use, which makes it difficult to illustrate costs.

In the lower portion of figure 11 (table 60, page 96), the average cost per kilowatt-hour is illustrated as it declines with increasing use of electricity per month. This again shows the saving due to changes in the residential rate schedule which was greater for small consumers than for large. It also illustrates the reduction in cost per kilowatt-hour which results from a shift to the "all electric" rate schedule.

Actual cost of electricity per year depends upon the level of consumption, the seasonal distribution, and applicable rate schedules. So far as seasonal distribution influences cost, it is more important for comparatively small users. During a relatively large part of the year these users may have a monthly use of electricity which gives them rates considerably below those resulting from the use of an average monthly consumption of electricity throughout the year.

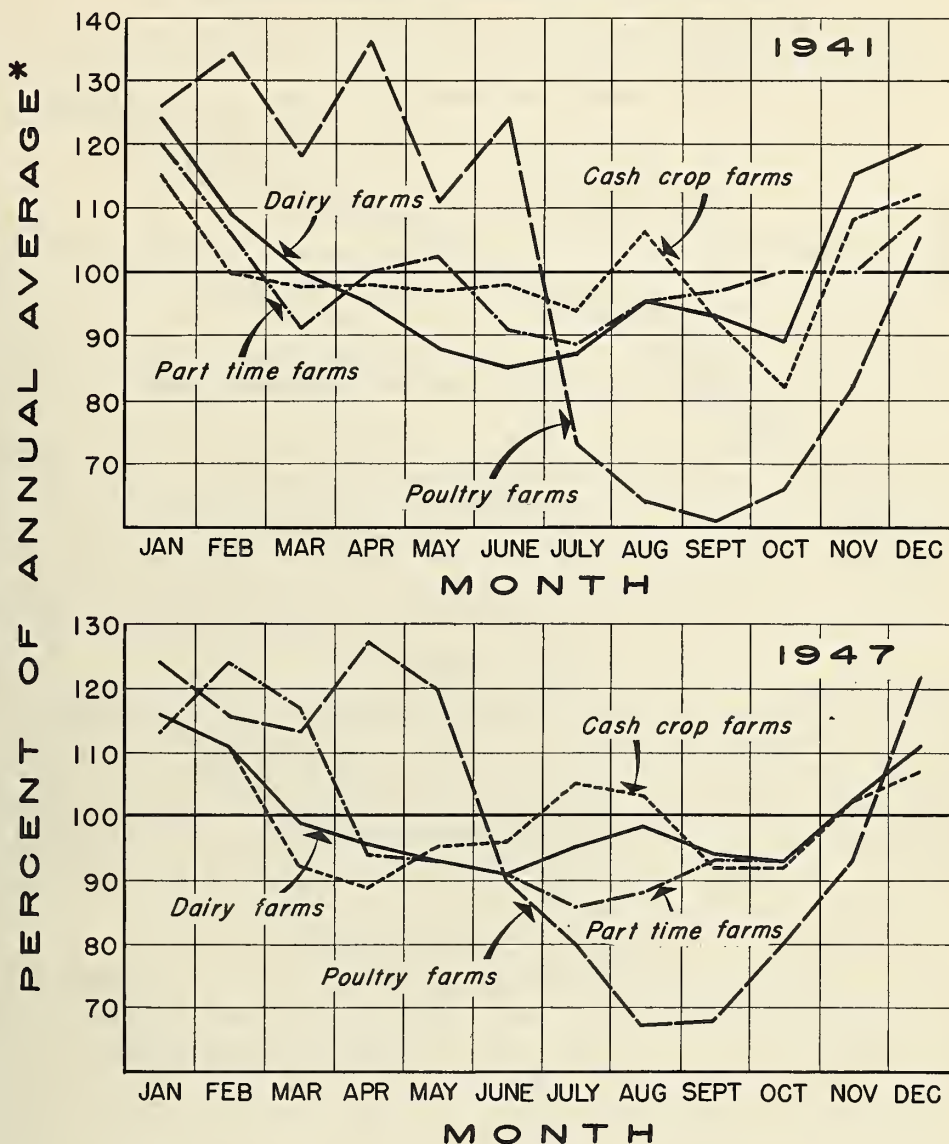
The weighted average annual costs of electricity on farms during the period 1938-47 are given in table 16. It will be recalled (table 2) that annual consumption in the area increased almost four times; annual costs increased by 85 percent. In general, the increase was proportionately greater for medium and large users than for those who used electricity less extensively. Also, in less productive locations (land classes 4 and 5) where farms had a more than average rate of increase in use, the increase in costs of electricity was proportionately greater than in better locations (land classes 1 and 2).

Rate schedules for users of electricity, although not specifically designed for the purpose, in effect encourage the widespread use of electricity by providing higher rates for small use and progressively lower rates up to a certain point for larger use. This makes the use of electricity relatively more expensive for small users who do not have the opportunities of increasing consumption to the same extent as large users. In 1938, farmers in the study area paid an average of about 3.3 cents per kilowatt-hour (table 61, page 97). In 1947, the cost per kilowatt-hour declined to 1.5 cents, a reduction of 53 percent. Greater consumption on farms which gave lower rates, plus reductions in rate and changes in schedules, resulted in this reduction. Average costs were calculated by dividing the average annual cost of electricity as shown in table 16 by the average consumption as given in table 2.

In 1938, the cost per kilowatt-hour for small users of electricity, represented by small, part-time, and subsistence farms, and by farms in land classes 4 and 5, was relatively high. In almost all cases, it exceeded 4 cents per kilowatt-hour. The rapid and proportionately large increase in consumption made by these users and the fact that reductions in rate resulted in greater benefits to them than to large consumers reduced the cost per kilowatt-hour more in actual values as well as proportionate to the level of costs per kilowatt-hour obtained in 1938. Their costs per kilowatt-hour were cut by more than 50 percent. In contrast to this, for large consumers (who are represented by large farms, by poultry and cash-crop farms, and by farms on land classes 1 and 2) the reduction in cost per kilowatt-hour was not so great. Their costs varied between 2 and 3 cents per kilowatt-hour in 1938 and were reduced by less than 50 percent. In spite of this relatively large reduction in 1947, the farmers in the study area paid a higher average cost per kilowatt-hour than the average paid by all residential users in the State of Washington.

# SEASONAL VARIATION IN CONSUMPTION OF ELECTRICITY BY TYPE OF FARMS

(NORTHWESTERN WASHINGTON 1941 & 1947)



\*MONTHLY CONSUMPTION CORRECTED FOR GROWTH DURING THE YEAR  
AVERAGE FOR THE YEAR EQUALS 100

Figure 10. Poultry farms showed the greatest seasonal variation. Other types of farms indicated greater fluctuations in consumption in 1947 than in 1941.

# MONTHLY BILL AND COST PER KWH FOR ELECTRICITY ON MAJOR RATE SCHEDULES

(NORTHWESTERN WASHINGTON 1938 & 1947)

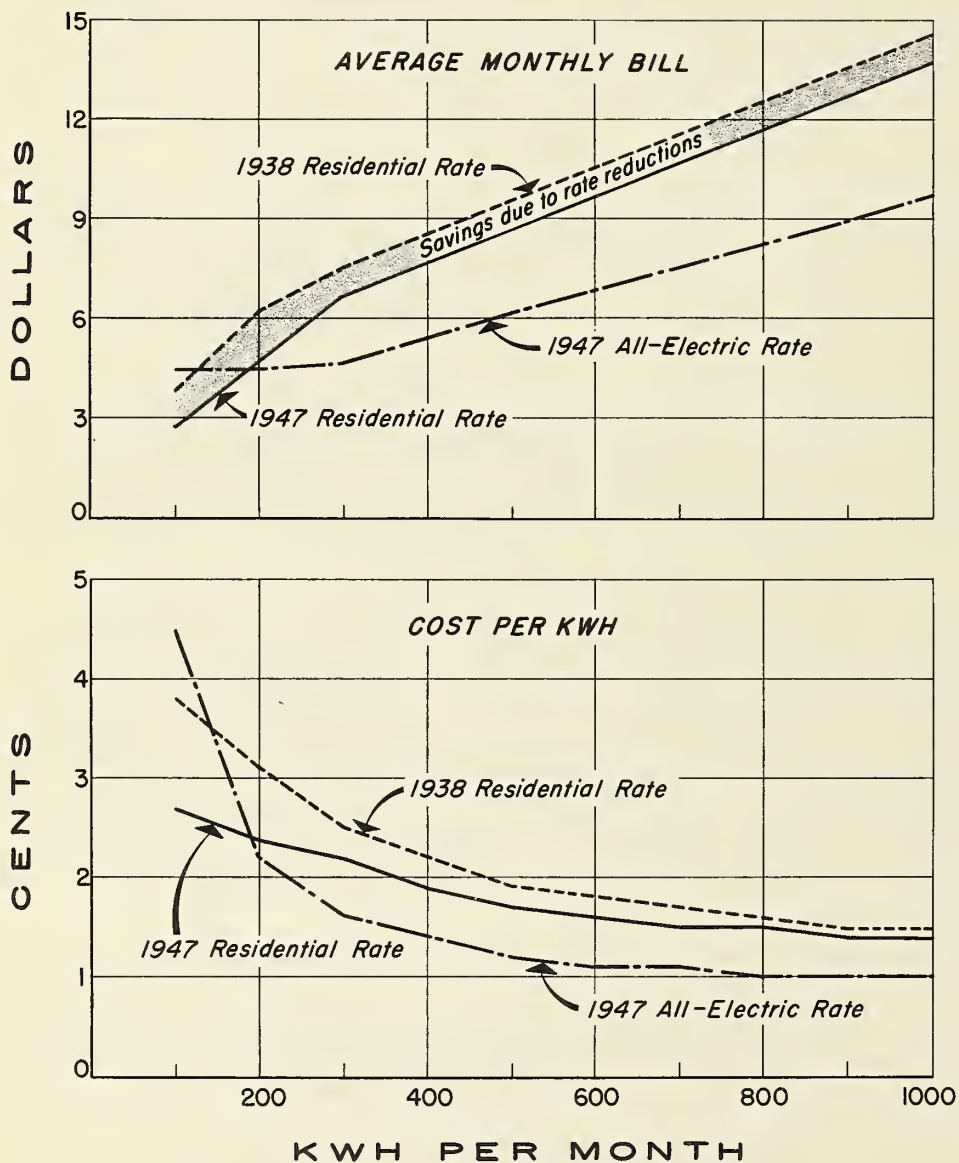


Figure 11. Monthly bills for electricity increase with increasing consumption but not in direct proportion. Cost per kilowatt-hour declines as consumption increases.

## USE OF ELECTRICITY ON DAIRY FARMS

Dairy farms constitute the largest individual type of farm represented in the area. The concentration of farm work on or near the farmstead and the many detailed jobs involved in dairy production make these farms adaptable, so far as organization is concerned, to extensive use of electricity on a year-round basis. Also, gradual changes toward increased production of market milk, coupled with stricter sanitary requirements, have necessitated the use of methods and appliances to meet existing standards. In milking, in having an adequate supply of hot water, in cooling to protect the milk against spoilage, and many other purposes, the use of electric appliances is often preferred to alternative methods or appliances. Obviously, the advisability of using the various methods or appliances depends upon several factors, of which the size of operation is probably most influential.

### Distribution of Farms in the Sample

In 1947, average consumption on large dairy farms was 9,984 kilowatt-hours, on medium-sized farms 5,708 kilowatt-hours, and on small dairy farms 3,462 kilowatt-hours. In order to learn the significance of these averages and their adequacy in describing the use of electricity on the respective sizes, the distribution of use on all farms in the particular size group must be examined. A tendency for the individual cases to concentrate around the average, with a relatively smooth deviation, indicates that the average is fairly representative of all farms in the sample.

Variations from the average have several causes, many of which are not measurable. Farms within a given size and type classification vary not only in number and size of electric appliances, but also in the extent of use. Cooking may be done with electricity or by means of an oil, gas, or wood stove. Similarly, hot water may be supplied by use of electricity or various other types of fuels. Then the consumption of electricity by specific appliances or equipment varies according to the size of the equipment as expressed in watts. Finally, the extent of use, daily or annual, depends primarily upon the amount of work to be done.

The majority of large dairy farms consumed between 5,000 and 10,000 kilowatt-hours of electricity each with an average fairly representative of the group as a whole. This is also the case for medium-sized dairy farms, of which the majority consumed between 4,000 and 6,000 kilowatt-hours. Only within the group of small dairy farms was the average consumption of about 3,500 kilowatt-hours not so representative of the group as those of larger sizes. A proportionately greater use of electricity in the home and the use of electricity for secondary enterprises, as poultry, accounts for a relatively high consumption on a few small dairy farms.

### Use of Electricity in Households

There is little doubt as to the saving in time and effort that can be accomplished through the use of electric household appliances on large farms. More farm dwellings, larger incomes, and more persons living on large farms account for this. On medium and small farms, sources of energy that compete with electricity in the dwellings become more and more prevalent as the size of farm and, with it, the income declines. Similarly, on land classes 1 and 2, where large farms predominate, there are more and larger farm dwellings, more persons living on each farm, and above all, incomes are considerably larger than on medium or small farms.

The major home appliances, from the viewpoint either of investment, use of power, or total number in use, are ranges, refrigerators, and water heaters. The proportions of dairy farms of different sizes reporting these appliances are given in table 17.

Table 17.-Persons living on farms, number and size of dwellings, and major electric and nonelectric home appliances on dairy farms, by size of farm and economic land use class, northwestern Washington, 1947

Item	Size of farm			Land use			All farms
	Large	Medium	Small	Classes 1 and 2	Class 3	Classes 4 and 5	
	Number	Number	Number	Number	Number	Number	Number
Farms .....	46	96	89	111	64	56	231
Persons per farm	6.0	4.0	3.4	4.3	4.1	4.0	4.2
Dwellings per farm	1.7	1.1	1.1	1.3	1.1	1.1	1.2
Rooms per dwelling	6.2	7.0	6.1	6.6	6.5	6.0	6.4
Home appliances							
Electric							
Percentage of farms reporting	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Ranges .....	63.0	44.8	25.8	49.6	37.5	28.6	41.1
Refrigerators	89.1	88.5	84.3	85.6	85.9	91.1	87.0
Water heaters	60.9	44.8	29.2	44.1	48.4	30.4	42.0
Cabinet freezers ..	10.9	1.0	1.1	3.6	1.6	3.6	3.0
Walk-in freezers ..	---	1.0	1.1	1.8	---	---	.9
Appliances per 100 farms	Number	Number	Number	Number	Number	Number	Number
Ranges .....	67	52	26	51	38	30	42
Water heaters	72	46	29	50	48	30	45
Refrigerators	107	91	84	92	88	95	91
Cabinet freezers ..	11	1	1	4	2	4	3
Walk-in freezers ..	---	1	1	2	---	---	1
Nonelectric							
Percentage of farms reporting	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Oil ranges ..	15.2	21.9	14.6	22.5	15.6	10.7	17.7
Wood ranges ..	26.1	18.8	36.0	27.0	21.9	32.1	26.8
Other ranges ..	10.9	15.6	27.0	8.1	28.1	30.4	19.0
Other water heaters ...	26.1	35.4	46.1	32.4	35.9	50.0	37.7
Appliances per 100 farms	Number	Number	Number	Number	Number	Number	Number
Oil ranges ..	15	23	15	22	16	12	18
Wood ranges ..	30	19	36	28	23	32	28
Other ranges ..	13	18	27	10	28	32	20
Other water heaters ...	28	36	46	33	36	54	39

Although the number of electric water heaters and ranges reported on dairy farms declined considerably as the size of farm declined, almost all farms, regardless of size, reported electric refrigerators in use in approximately the same proportion. Apparently, electric refrigerators have no real competition. Other fuels, however, compete more or less in cooking and heating water. The extent to which nonelectric appliances were reported is given in the lower part of table 17. Wood ranges with coils for heating water were found more frequently, particularly on small farms which were less favorably located (land classes 4 and 5).

Refrigerators were the more common of the major electric home appliances, and generally had been installed earlier than ranges and water heaters. On large farms they had been installed at a somewhat earlier date than on medium and small farms. More than 50 percent of all dairy farms reported refrigerators connected before 1945, whereas most of the ranges and water heaters were connected in 1945 and later. The percentage of the three major home appliances wired during specified periods is given in table 18.

Table 18.- Percentage distribution of major home electric appliances on dairy farms, by size of farm and period connected, northwestern Washington.

Electric appliance	Farms			Percentage connected				
	Size	Total	Reporting date connected	Before 1935	1935-39	1940-44	1945-46	1947
		Number	Number	Percent	Percent	Percent	Percent	Percent
Range . . . .	Large	46	27	22.2	11.1	25.9	11.1	29.7
	Medium	96	40	10.0	7.5	22.5	30.0	30.0
	Small	89	23	8.7	13.0	17.5	30.4	30.4
	All	231	90	13.3	10.0	22.2	24.5	30.0
Refrigerator	Large	46	40	12.5	30.0	35.0	5.0	17.5
	Medium	96	78	3.8	20.5	42.3	14.1	19.2
	Small	89	70	4.3	25.7	37.1	18.6	14.3
	All	231	188	5.9	24.5	38.8	13.8	17.0
Water heater	Large	46	26	11.5	11.5	26.9	11.5	38.6
	Medium	96	40	2.5	5.0	20.0	32.5	40.0
	Small	89	26	3.8	7.7	15.4	46.2	26.9
	All	231	92	5.4	7.6	20.7	30.4	35.9

Other electric home appliances either require little electricity because of their nature or infrequent use or are of a kind found less frequently on farms. The former group would include such appliances as clocks, irons, radios, and washing machines; the latter, such items as electric blankets, dishwashers, roasters, space heaters, and freezers. A list of these appliances and the number reported per 100 farms are given in table 62, page 98.

On the basis of an estimated average annual consumption of electricity for each appliance, the average use of electricity in the farm home was calculated at 5,256 kilowatt-hours for large dairy farms, 3,662 kilowatt-hours for medium-sized dairy farms, and 2,653 kilowatt-hours for small dairy farms. The method used in calculating household use is shown in table 19. Average annual consumption for each appliance was estimated from various published and unpublished data. 8/

Table 19.- Estimated consumption of electricity in farm households on dairy farms, by size of farm and by appliances, northwestern Washington, 1947.

Item	: Average : : consump- : tion : : per unit :	Dairy farms 1/					
		Large		Medium		Small	
		Units	Quantity	Units	Quantity	Units	Quantity
		reported	consumed	reported	consumed	reported	consumed
	: Kw.-hrs.	No.	Kw.-Hrs.	No.	Kw.-Hrs.	No.	Kw.-Hrs.
Lighting . . . . .	300	77	23,100	109	32,700	96	28,800
Blankets . . . . .	30	1	30	1	30	2	60
Broilers . . . . .	100	2	200	1	100	2	200
Clocks . . . . .	20	67	1,340	119	2,380	66	1,320
Dishwashers . . . . .	30	1	30	---	---	1	30
Exhaust fans . . . . .	30	3	90	1	30	3	90
Food mixers . . . . .	15	30	450	53	795	29	435
Cabinet freezers . . . . .	900	5	4,500	1	900	1	900
Walk-in freezers . . . . .	1,800	---	---	1	1,800	1	1,800
Heating pads . . . . .	12	15	180	41	492	34	408
Hot-air circ. fans . . . . .	25	13	325	17	425	11	275
Hot-water pumps . . . . .	180	3	540	1	180	4	720
Hot plates . . . . .	100	32	3,200	69	6,900	69	6,900
Irons . . . . .	75	55	4,125	103	7,725	88	6,600
Ironers . . . . .	120	11	1,320	6	720	3	360
Oil furnaces . . . . .	250	11	2,750	6	1,500	7	1,750
Percolators . . . . .	80	26	2,080	40	3,200	39	3,120
Radios . . . . .	100	88	8,800	164	16,400	141	14,100
Electric ranges . . . . .	1,350	31	41,850	50	67,500	23	31,050
Refrigerators . . . . .	400	49	19,600	87	34,800	75	30,000
Roasters . . . . .	300	4	1,200	2	600	4	1,200
Sewing machines . . . . .	10	12	120	27	270	13	130
Space heaters . . . . .	240	9	2,160	18	4,320	18	4,320
Toasters . . . . .	45	40	1,800	77	3,465	67	3,015
Vacuum cleaners . . . . .	15	41	615	77	1,155	51	765
Waffle irons . . . . .	25	37	925	76	1,900	61	1,525
Washing machines . . . . .	30	51	1,530	95	2,850	87	2,610
Elec. water heaters . . . . .	3,600	33	118,800	44	158,400	26	93,600
Other . . . . .	---	4	100	2	60	---	---
Total . . . . .			241,760		351,597		236,083
Average per farm . . . . .			5,256		3,662		2,653

1/ Number of farms: Large, 46; Medium, 96; Small, 89.

8/ Sources for this information were Bonneville Power Administration, Edison Electric Institute, Rural Electrification Administration, Federal Power Commission, and Westinghouse Electric Corporation. Variations in the estimated consumption of each appliance obtained from different sources were relatively small. However, as estimates were to be made for conditions in the Northwest, those of the Bonneville Power Administration were chiefly relied upon.

Average household use was calculated by multiplying the number of appliances in each size group by the respective estimated average use. The total kilowatt-hour consumption for all appliances in each group was then divided by the number of farms in the group. The estimated annual use of all household appliances is an average for all farms with some using more, some using less.

### Use of Electricity in Farm Operations

Consumption of electricity for farm operations is influenced not only by the type and size of the predominant enterprise on farms but also by the type and size of supplementary enterprises and the specific organization of the individual farm. Very few farms have only a single enterprise. On most dairy farms a supplementary cash-crop or poultry enterprise is included in the organization. These result in a better utilization of available labor or supplement the dairy enterprise in other respects. Furthermore, a dairy farm of a given size may deliver bottled milk directly to consumers, market milk to a distributor, or manufacturing milk to a processor. The organization of the farm varies in each case and the use of electricity, mainly because of different sanitary requirements and handling of the product, varies greatly.

The dairy farms in the area were fairly uniform as to organization. Dairy barns were separate from the barns used for young stock and other kinds of livestock. Most of these farms had milk houses and delivered market milk to distributors. More than half had poultry laying houses and 10 percent had poultry brooder houses. Although city water was available on almost half of the farms, 71 percent had water-pressure systems for cooling milk and watering stock. Electric milkers were in use on 87 percent of the dairy farms; the remaining 13 percent used the hand method primarily. Only 3 percent of the farms had electric milk coolers but a relatively large proportion (70 percent) had electric hot-water heaters for the dairy. The poultry enterprise used comparatively little electricity, although more than half of the dairy farms reported that they lighted their poultry laying houses.

The number of buildings connected and the availability of major farm appliances (table 63, page 99 ) and their indicated use generally declined as the size of farm declined and the location became less favorable (table 20). There were some noticeable exceptions. As proportionately fewer small dairy farms were connected with a city water supply, a larger number of those reported water-pressure systems in operation. The poultry enterprise on small dairy farms, particularly in the poorer locations (land classes 4 and 5), was relatively more important than on large dairy farms and farms in better locations.

Of the major farm buildings, the number of which affects the use of electricity in farm operations, poultry laying houses (table 21) had generally been connected at an earlier date than milk houses. The construction and wiring of milk houses is of somewhat more recent date because of an accelerated change-over from production of manufacturing milk to production of market milk and the generally stricter sanitary regulations in effect. Of the major farm appliances, milking machines and water heaters are of primary significance. Although a few milking machines were installed early, about two-thirds have been connected since 1940. Of the electric water heaters, only about 13 percent were installed before 1940.

On the basis of average consumption of electricity for individual uses, total farm consumption was estimated similarly to that for household use, except that for most electric farm appliances the annual use or amount of production was obtained, and consumption was more closely related to use than was possible for home appliances. The rates used in estimating power use on dairy and all other types of farms are given in table 22.

Large dairy farms had an average consumption of electricity for farm use of 4,705 kilowatt-hours; medium-sized dairy farms, 2,197 kilowatt-hours; and small dairy farms, 1,043 kilowatt-hours. Average annual consumption of electricity by major farm enterprises and individual appliances is given in table 23 by size of farm. Approximately 78 percent of the total farm use of electricity on large dairy farms was used for the dairy enterprise. Water heaters and milking machines were the major individual uses. Of major significance in this size group was the use of electricity for supplementary irrigation. On medium and small dairy farms, a higher proportion of the electricity consumed in farming was used for the dairy enterprise, 87 and 83 percent, respectively. Other uses are of little significance.

Table 20.- Number and percentage electrified of farm buildings and major farm appliances on dairy farms, by size of farm and economic land use, northwestern Washington, 1947.

Item	Unit	Size of farm			Land use			
		Large	Medium	Small	Classes : 1 and 2	Class : 3	Classes : 4 and 5	All farms
Farms	Number	46	96	89	111	64	56	231
Dairy barns								
Per 100 farms	Number	98	90	92	95	89	91	92
Percentage connected	Percent	97.8	100.0	88.8	98.1	100.0	87.5	98.1
General barns								
Per 100 farms	Number	67	41	28	44	47	29	41
Percentage connected	Percent	83.9	97.4	100.0	91.8	96.7	93.7	93.7
Milk houses								
Per 100 farms	Number	85	89	76	88	86	70	83
Percentage connected	Percent	100.0	98.8	95.6	99.0	98.2	94.9	98.0
Poultry laying houses								
Per 100 farms	Number	39	57	57	50	42	75	54
Percentage connected	Percent	88.9	74.5	70.6	81.8	70.4	69.0	75.0
Poultry brooder houses								
Per 100 farms	Number	2	8	17	8	11	14	10
Percentage connected	Percent	---	87.5	66.7	88.9	57.1	62.5	71.0
Farm shops								
Per 100 farms	Number	43	44	35	48	25	4	40
Percentage connected	Percent	100.0	88.1	77.4	86.8	93.7	83.3	87.1
Yard lights								
Per 100 farms	Number	50	55	64	51	56	71	58
City water supply								
Per 100 farms	Number	52	52	40	67	38	21	48
One water pressure system								
Per 100 farms	Number	50	76	75	63	70	86	71
Percentage connected	Percent	91.3	89.0	95.5	90.0	95.5	91.7	92.0
Second water pressure system								
Per 100 farms	Number	15	1	1	5	2	4	4
Percentage connected	Percent	95.7	100.0	100.0	83.3	100.0	100.0	88.9
Electric milking machines								
Per 100 farms	Number	98	90	79	90	92	75	87
Average number of cows	Number	39.7	19.9	10.8	23.4	21.2	15.8	21.2
Nonelectric milking, incl. hand								
Per 100 farms	Number	2.2	10.4	20.2	9.0	7.8	25.0	12.6
Average number of cows	Number	45	19.0	8.0	17.7	13.2	9.7	13.1
Electric milk coolers								
Per 100 farms	Number	9	2	1	4	5	---	3
Electric water heaters								
Per 100 farms	Number	87	79	51	74	78	52	70
Lighting in poultry laying houses								
Per 100 farms	Number	26	32	29	24	25	46	30
Average number of laying hens	Number	119.5	126.5	36.6	94.1	112.2	64.4	88.2
Electric brooder hovers								
Per 100 farms	Number	7	17	12	13	11	16	13
Electric brooder batteries								
Per 100 farms	Number	---	1	---	---	2	---	.4
Electric welders								
Per 100 farms	Number	7	3	1	2	3	5	3

Table 21. - Percentage distribution of major electrified farm buildings and appliances on dairy farms, by size of farm and period connected, northwestern Washington

Item	Farms			Percentage connected				
	Size	Total	Reporting date connected	Before 1935	1935-39	1940-44	1945-46	1947
				Percent	Percent	Percent	Percent	Percent
Milk house . . . . .	Large	46	34	50.0	8.8	17.7	14.7	8.8
	Medium	96	67	49.2	20.9	9.0	13.4	7.5
	Small	89	52	36.5	26.9	11.6	7.7	17.3
	All	231	153	45.0	20.3	11.8	11.8	11.1
Poultry laying house	Large	46	14	64.3	28.6	7.1	---	---
	Medium	96	32	72.0	6.2	12.5	6.2	3.1
	Small	89	27	48.2	25.9	11.1	7.4	7.4
	All	231	73	61.6	17.8	11.0	5.5	4.1
Milking machine . . .	Large	46	42	35.7	19.0	31.0	9.5	4.8
	Medium	96	84	11.9	16.7	44.0	25.0	2.4
	Small	89	68	10.3	14.7	32.3	30.9	11.8
	All	231	194	16.5	16.5	37.1	23.7	6.2
Milk cooler . . . . .	Large	46	5	20.0	---	40.0	---	40.0
	Medium	96	3	---	---	66.7	---	33.3
	Small	89	1	---	---	---	---	100.0
	All	231	9	11.2	---	44.4	---	44.4
Water heater . . . . .	Large	46	37	10.8	13.5	27.1	24.3	24.3
	Medium	96	72	---	9.7	47.2	29.2	13.9
	Small	89	45	---	11.1	28.9	28.9	31.1
	All	231	154	2.6	11.0	37.1	27.9	21.4
Electric welder . . .	Large	46	2	---	---	50.0	---	50.0
	Medium	96	2	---	50.0	50.0	---	---
	Small	89	1	---	---	---	100.0	---
	All	231	5	---	20.0	40.0	20.0	20.0

When estimated farm use of electricity on dairy farms is added to that of household use, the total closely approximates total consumption of electricity as reported. For this presentation (table 23, last 4 lines) neither the saturation of appliances nor the total consumption of power were weighted. In both cases the actual use of appliances as reported and the estimated consumption of power was used.

The proportion of electricity used in the farm homes on dairy farms (figure 14) exceeds that used on the farm. On large dairy farms, 53 percent of the total was used in the homes, on medium-sized farms 63 percent, and on small farms 72 percent. Although household uses of electricity decline as the size of farm, expressed in productive man-work units, becomes smaller, farm uses decline more rapidly.

#### Seasonal Variation in Consumption of Electricity

Together with a considerable increase in consumption of electricity on dairy farms between 1941 and 1947, the seasonal pattern has changed during this period. Consumption in November, December, and January did not increase in proportion to the average of all months and in relation to the increase from April to October. The low points during the year, the months of June and October, remained the same. Although actual consumption in November and December was considerably higher than in January (table 24),



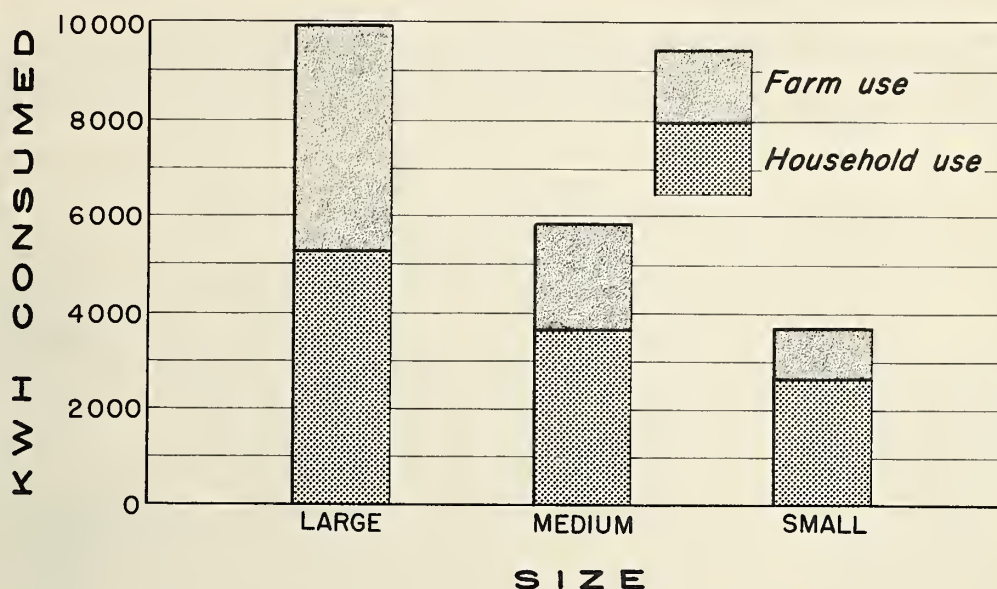
Figure 12. Milking machines are universally in use where the size of enterprise justifies them.



Figure 13. A geared hoist on overhead track saves back-breaking labor when putting filled milk cans into an electric cooling tank.

## ESTIMATED FARM AND HOUSEHOLD USES OF ELECTRICITY ON DAIRY FARMS, BY SIZE OF FARM

(NORTHWESTERN WASHINGTON 1947)



U.S. DEPARTMENT OF AGRICULTURE

NEG. 47777 - BUREAU OF AGRICULTURAL ECONOMICS

Figure 14. On dairy farms, household uses of electricity exceeded farm uses. On large dairy farms, however, the consumption of electricity in the farm business was proportionately much greater than on smaller farms.

if data are corrected for increase during the season, consumption in January exceeds that at the end of the year.

Seasonal variation in consumption of electricity was greater on small farms, particularly during 1941. As the primary use of electricity by small consumers is for lighting purposes, the lighting load constitutes the major influence upon seasonal distribution. As additional appliances are added, both in the home and on the farm, and are in use more or less throughout the year, the seasonal pattern changes because the lighting ceases to be the main influence upon seasonal distribution. On large farms, the change in the seasonal pattern from 1941 to 1947 was less pronounced, as the level of consumption reached in 1941 indicated that lighting was no longer the main factor in influencing seasonal distribution of consumption. The relatively high consumption in August of 1947 may be due to supplementary irrigation on large dairy farms but no reasonable explanation is apparent for the fact that consumption in August 1941 was apparently higher than in the preceding or succeeding months.

## USE OF ELECTRICITY ON POULTRY FARMS

Production of poultry in northwestern Washington has reached a high degree of specialization. Poultry feeds cannot be grown well in western Washington in competition with other crops, so almost all poultry farmers buy their feed supplies from commercial sources. This necessitates a certain degree of specialization and efficient operation if they are to compete with producers elsewhere. Because of this situation, poultry farmers are exposed much more to the effects of the feed-egg ratio than dairy farmers, for example, (who grow most of their roughage supplies) are exposed to fluctuations in the price of milk.

High specialization in poultry production brings with it the use of modern methods and appliances which tend to reduce operating costs by increasing output per unit of input or by reducing labor requirements and making it possible to increase the efficiency of labor.

Table 22.- Estimated average consumption of electricity of farm appliances,  
northwestern Washington

Item	: Kilowatt-hours : : per : following units :	Average : consumption : per unit
Dairy enterprise	:	:
Milking machine	: Cow	: 30
Cooler	: 10 gallons	: 1
Water heater	:	:
Large dairy	: Year	: 2,000
Medium dairy	: do.	: 1,500
Small dairy	: do.	: 1,000
Poultry enterprise	:	:
Brooder	: Chick	: 1
Incubator	: 100 eggs	: 20
Water warmer	: Day	: 1
Water pumping	:	:
System #1	: Foot lift	: 12
System #2	: do.	: 9
Farm equipment	:	:
Roughage elevator	: 10 tons	: 1
Ensilage cutter	: 1 ton	: 1
Hay hoist	: 10 tons	: 4
Feed grinder	: 1 ton	: 10
Feed chopper	: 1 ton	: 1
Feed mixer	: 1 ton	: 1
Electric fence	: Fence system	: 50
Farm shop	:	:
Wood saw	: Year	: 30
Air compressor	: do.	: 35
Drill press	: do.	: 12
Tool grinder	: do.	: 25
Power saw	: do.	: 12
Welding	: do.	: 100
Battery charger	: do.	: 12
Lathe	: do.	: 10
Forge	: do.	: 12
Concrete mixer	: do.	: 25
Soldering iron	: do.	: 15
Electric drill	: do.	: 10

The types of poultry farms found in the area vary considerably. Some farms specialize in custom hatchery operations only; others hatch eggs and raise replacement stock for sale. Still others buy replacement stock for production of eggs or poultry meat. In production of poultry meat, the raising of fryers was slightly more common than the raising of turkeys. The type and extent of production changes from season to season, depending upon market prospects. In general, a larger variety of different kinds of specialized poultry operations were found among the group of large farms; on medium-sized and small poultry farms, production of eggs was by far the most prominent.

The kind of poultry production influences the use of electricity, as certain appliances are better suited to it than others. Poultry farms of large and medium sizes consumed more electricity in 1947 than other types of farms in comparable size groups. The weighted average use on large poultry farms was 15,336 kilowatt-hours; on medium-sized poultry farms, 7,933 kilowatt-hours; and on small poultry farms, 3,178 kilowatt-hours.

Table 23.- Consumption of electricity per dairy farm, by size of farm, and by farm operations, northwestern Washington, 1947.

Item	Dairy farms <sup>1/</sup>		
	Large	Medium	Small
	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.
Farm operations			
Dairy enterprise			
Milking machines . . . . .	1,098	526	267
Cooler . . . . .	593	62	24
Water heater . . . . .	1,739	1,188	506
Light and other . . . . .	229	142	66
Total . . . . .	3,659	1,918	863
Poultry enterprise			
Brooders . . . . .	13	35	14
Incubators . . . . .	---	---	---
Lights and other . . . . .	4	6	1
Total . . . . .	17	41	15
Miscellaneous uses			
Farm equipment . . . . .	42	43	40
Farm shop . . . . .	30	26	16
Water pumping . . . . .	141	142	94
Irrigation . . . . .	741	---	---
Lights not included above . . . . .	75	27	15
Total . . . . .	1,029	238	165
Total farm operations . . . . .	4,705	2,197	1,043
Farm household			
Grand total . . . . .	5,256	3,662	2,653
Estimated . . . . .	9,961	5,859	3,696
Actual . . . . .	9,984	5,708	3,462

<sup>1/</sup> Number of farms: Large, 46; Medium, 96; Small, 89.

### Distribution of Farms in the Sample

The relatively large use of electricity on poultry farms originates in the poultry enterprise. Household uses do not differ greatly from those of other types of farms having comparable incomes.

Distribution of farms within each size group according to volume of power consumption indicates that there is little concentration around the average. Thus, the sample, partly because of a relatively small number of cases and partly because of greatly varying consumption from farm to farm, is less representative than was the case for dairy farms. Although the sample was increased greatly above the number necessary for a proportionate representation of poultry farms in the area, considerable variation in consumption per farm remains.

This variation is due partly to the different kinds of poultry production that may be carried on and partly to the different methods used in the production of one particular kind of poultry. An analysis of consumption of power by kinds of poultry enterprises was not feasible because of the many variations in methods used and the small number of cases in each grouping. Even on poultry farms that specialize in production of eggs, which is the predominant type, methods vary considerably. Some operators hatch their own chicks, others buy day-old chicks from the hatchery; some use lighting for pullets, others use it for laying hens only. Unfortunately, the effect of different methods, which involve varying amounts of electricity, upon net income cannot be isolated because of insufficient information as to the detail of operation and the wide variety of factors involved.

On large poultry farms, consumption of electricity varies from 81,000 kilowatt-hours per year on a commercial-type hatchery producing hatching eggs and replacement stock, to as low as 1,100 kilowatt-hours. The scatter of individual cases was somewhat less on medium-sized poultry farms. In 1947, about 27 percent of these used 2,000 kilowatt-hours or less and 18 percent consumed more than 10,000 kilowatt-hours that year. On small poultry farms, average consumption for the group is somewhat more representative, but even in this group the mode was below the arithmetic average. About 55 percent of the small poultry farms consumed less than 2,000 kilowatt-hours in 1947. Greater uniformity in the kind of poultry production accounts for a better frequency distribution.

Table 24.- Weighted average consumption of electricity on dairy farms, northwestern Washington, monthly 1941 and 1947 <sup>1/</sup>

Month	1941	1947
	Kilowatt-hours	Kilowatt-hours
January . . . . .	147	393
February . . . . .	133	386
March . . . . .	126	358
April . . . . .	121	355
May . . . . .	116	355
June . . . . .	114	356
July . . . . .	118	374
August . . . . .	129	389
September . . . . .	129	386
October . . . . .	126	388
November . . . . .	156	423
December . . . . .	163	457
Total . . . . .	1,578	4,620

<sup>1/</sup> Actual monthly consumption not corrected for increase during the year.

Table 25.-Persons living on farm, number and size of dwellings, and major electric and nonelectric home appliances on poultry farms, by size of farm and economic land use class, northwestern Washington, 1947.

Item	Size of farm			Land use			
	Large	Medium	Small	Classes 1 and 2	Class 3	Classes 4 and 5	All farms
	Number	Number	Number	Number	Number	Number	Number
Farms . . . . .	23	30	50	7	21	75	103
Persons per farm . . .	5.6	3.2	2.7	5.0	3.6	3.3	3.5
Dwellings per farm . .	1.6	1.1	1.0	1.4	1.1	1.1	1.2
Rooms per dwelling . .	4.9	5.8	5.5	5.1	5.9	5.3	5.4
Home appliances							
Electric							
Percentage of farms reporting . .	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Ranges . . . . .	56.5	36.7	30.0	71.4	28.6	37.3	37.9
Water heaters . . . .	56.5	43.3	30.0	71.4	33.3	38.7	39.8
Refrigerators . . . .	91.3	86.7	58.0	85.7	76.2	72.0	73.8
Cabinet freezers . . . .	13.0	---	4.0	14.3	4.8	4.0	4.8
Walk-in freezers . . . .	---	3.3	---	---	4.8	---	1.0
Appliances per 100 farms	Number	Number	Number	Number	Number	Number	Number
Ranges . . . . .	61	37	30	71	29	39	39
Water heaters . . . .	70	43	30	86	43	39	40
Refrigerators . . . .	117	87	60	86	90	77	81
Cabinet freezers . . . .	22	---	4	14	5	7	7
Walk-in freezers . . . .	---	3	---	---	5	---	1
Nonelectric							
Percentage of farms reporting . .	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Oil ranges . . . . .	21.7	16.7	14.0	28.6	19.0	14.7	16.5
Wood ranges . . . . .	21.7	36.7	44.0	14.3	52.4	34.7	36.9
Other ranges . . . . .	17.4	13.3	10.0	---	9.5	14.7	12.6
Other water heaters . . . .	13.0	23.3	26.0	14.3	19.0	24.0	22.3
Appliances per 100 farms	Number	Number	Number	Number	Number	Number	Number
Oil ranges . . . . .	30	17	14	57	19	15	18
Wood ranges . . . . .	26	37	44	14	57	35	38
Other ranges . . . . .	17	13	10	---	10	15	13
Other water heaters . . . .	13	23	26	14	19	24	22

### Use of Electricity in Households

Average use of electricity in households on poultry farms compares well with use in households on dairy farms. There is considerable variation between sizes of poultry farms.

Large poultry farms have more and larger farm dwellings and more persons living on the farm than have the smaller farms. This is also true for poultry farms on land classes 1 and 2, compared with those in less favorable locations. The latter have fewer and smaller dwellings per farm and fewer persons living on farms.

The number and size of farm buildings and the availability of major electric and non-electric home appliances are given in table 25 (table 64, page 100). Water heaters and ranges were reported in almost the same proportions for all size groups of poultry farms. Refrigerators were reported by a comparatively large number in the large- and medium-sized groups, but were less common on small poultry farms. Cabinet and walk-in freezers are relatively new appliances and are not in common use.

Of the competing types of appliances in the farm home, wood ranges were more common, particularly on medium and small poultry farms, than on dairy farms, but fewer oil and other types of ranges were reported. Other than electric water heaters were found less frequently on poultry than on dairy farms.

Electric refrigerators were wired on poultry farms chiefly after 1940, while water heaters and ranges are of somewhat more recent date (table 26). Only 11 percent of the water heaters and 26 percent of the ranges were connected before 1940. Although only 25 percent of the refrigerators were bought before that date, a great increase in connections of this appliance occurred during the period from 1940 to 1944.

Table 26.- Percentage distribution of major home electric appliances on poultry farms, by size of farm and period connected, northwestern Washington.

Electric appliance	Size	Farms		Percentage connected					
		Total	Reporting date connected	Before 1935	1935-39	1940-44	1945-46	1947	
		Number	Number	Percent	Percent	Percent	Percent	Percent	
Range . . . .	Large	23	12	16.7	16.7	25.0	16.6	25.0	
	Medium	30	9	11.1	11.1	11.1	44.5	22.2	
	Small	50	14	21.4	---	28.6	14.3	35.7	
	All	103	35	17.1	8.6	22.8	22.9	28.6	
Refrigerator	Large	23	21	14.3	14.3	47.6	14.3	9.5	
	Medium	30	25	4.0	8.0	36.0	36.0	16.0	
	Small	50	26	3.8	30.8	46.2	7.7	11.5	
	All	103	72	6.9	18.1	43.1	19.4	12.5	
Water heater	Large	23	11	---	18.3	36.3	36.3	9.1	
	Medium	30	11	---	9.1	9.1	54.5	27.3	
	Small	50	13	7.7	---	30.8	15.4	46.1	
	All	103	35	2.8	8.6	25.7	34.3	28.6	

Estimates of consumption of electricity in households on poultry farms (table 27), were prepared in the same way as those for households on dairy farms. On this basis, home use was calculated at an average of 5,520 kilowatt-hours for large poultry farms, 3,375 kilowatt-hours for medium-sized farms, and 2,550 kilowatt-hours for small poultry farms. Home use constituted 36, 49, and 68 percent of the total estimated consumption for all uses on large, medium, and small poultry farms, respectively. This is the only type of farm found in the area on which, on the large and medium sizes, the estimated home consumption of electricity did not exceed farm use.

### Use of Electricity in Farm Operations

Although the chief use of electricity on poultry farms is for the poultry enterprise, a considerable number of farms reported supplementary enterprises of some significance with regard to the use of power, particularly in locations with relatively good resources (land classes 1 and 2). Almost 40 percent of all poultry farms reported dairy barns and

Table 27.- Estimated consumption of electricity in farm households on poultry farms, by size of farm and by appliances, northwestern Washington, 1947

Item	Average consump- tion per unit	Dairy farms 1/					
		Large		Medium		Small	
		Units reported	Quantity consumed	Units reported	Quantity consumed	Units reported	Quantity consumed
		Kw.-Hrs.	No.	Kw.-Hrs.	No.	Kw.-Hrs.	No.
Lighting . . . . .	300	37	11,100	32	9,600	51	15,300
Blankets . . . . .	30	2	60	1	30	2	60
Broilers . . . . .	100	1	100	---	---	1	100
Clocks . . . . .	20	38	760	37	740	44	880
Dishwashers . . . . .	30	---	---	---	---	1	30
Exhaust fans . . . . .	30	2	60	1	30	---	---
Food mixers . . . . .	15	18	270	11	165	21	315
Cabinet freezers . . . . .	900	5	4,500	---	---	22	1,800
Walk-in freezers . . . . .	1,800	---	---	1	1,800	---	---
Heating pads . . . . .	12	12	144	16	192	22	264
Hot-air circ. fans . . . . .	25	6	150	10	250	10	250
Hot-water pumps . . . . .	180	1	180	1	180	1	180
Hot plates . . . . .	100	24	2,400	16	1,600	29	2,900
Irons . . . . .	75	35	2,625	30	2,250	47	3,525
Ironers . . . . .	120	4	480	5	600	3	360
Oil furnaces . . . . .	250	7	1,750	4	1,000	1	250
Percolators . . . . .	80	12	960	9	720	13	1,040
Radios . . . . .	100	55	5,500	46	4,600	66	6,600
Ranges . . . . .	1,350	14	18,900	11	14,850	15	20,250
Refrigerators . . . . .	400	27	10,800	26	10,400	30	12,000
Roasters . . . . .	300	3	900	---	---	2	600
Sewing machines . . . . .	10	10	100	7	70	5	50
Space heaters . . . . .	240	19	4,560	11	2,640	5	1,200
Toasters . . . . .	45	28	1,260	21	945	39	1,755
Vacuum cleaners . . . . .	15	21	315	21	315	34	510
Waffle irons . . . . .	25	25	625	25	625	36	900
Washing machines . . . . .	30	29	870	28	840	45	1,350
Water heaters . . . . .	3,600	16	57,600	13	46,800	15	54,000
Other . . . . .	---	---	---	1	20	2	1,020
Total . . . . .			126,969		101,262		127,489
Average per farm . . . . .			5,520		3,375		2,550

1/ Number of farms: Large, 23; Medium, 30; Small, 50.

17 percent had milk houses (table 28 and table 65, page 101). A dairy enterprise was more common on large poultry farms in better locations than on small farms in less favorable locations.

On the average of all farms, there were about 2 laying houses per farm and 1-1/3 brooder houses. All laying houses were wired, but slightly more than half of the brooder houses had electric connections. The number of these buildings per farm changed in proportion to the size of the enterprise. The relatively small number of brooder houses that have electric connection may be accounted for by the fact that many poultry farmers in the area prefer other fuels for brooders. Only 53 and 11 percent of all poultry farms reported electric brooder hovers and brooder batteries, respectively. Lighting in laying houses is rather common; 95 percent of all farms reported the use of lights at sometime during the year to increase production.

Table 28.- Number and percentage electrified of farm buildings and major farm appliances on poultry farms by size of farm and economic land use, northwestern Washington, 1947.

Item	Unit	Size of farm			Land use			All farms
		Large	Medium	Small	Classes : 1 and 2 :	Class : 3	Classes : 4 and 5 :	
Farms .....	Number :	23	30	50	7	21	76	103
Dairy barns .....	Number :							
Per 100 farms .....	Number :	52	43	30	86	38	35	39
Percentage connected .....	Percent :	91.7	92.3	100.0	83.3	100.0	96.1	95.0
General barns .....	Number :							
Per 100 farms .....	Number :	56	27	42	57	33	41	41
Percentage connected .....	Percent :	84.6	100.0	100.0	100.0	85.7	96.8	95.2
Milk houses .....	Number :							
Per 100 farms .....	Number :	9	17	22	71	24	11	17
Percentage connected .....	Percent :	100.0	100.0	90.9	100.0	100.0	87.5	94.4
Poultry laying houses .....	Number :							
Per 100 farms .....	Number :	261	230	168	142	229	207	207
Percentage connected .....	Percent :	98.3	100.0	100.0	100.0	100.0	99.3	99.5
Poultry brooder houses .....	Number :							
Per 100 farms .....	Number :	213	140	100	214	81	145	137
Percentage connected .....	Percent :	42.8	62.0	58.0	40.0	88.2	50.4	53.9
Farm shops .....	Number :							
Per 100 farms .....	Number :	39	17	18	57	19	20	22
Percentage connected .....	Percent :	100.0	100.0	77.8	100.0	100.0	86.7	91.3
Yard lights .....	Number :							
Per 100 farms .....	Number :	74	47	52	86	52	53	55
City water supply .....	Number :							
Per 100 farms .....	Number :	30	40	42	57	72	28	39
One water pressure system .....	Number :							
Per 100 farms .....	Number :	52	70	78	71	57	73	70
Percentage connected .....	Percent :	91.7	95.2	94.9	80.0	100.0	94.5	94.4
Second water pressure system .....	Number :							
Per 100 farms .....	Number :	39	3	6	---	5	16	13
Percentage connected .....	Percent :	77.8	100.0	100.0	---	100.0	83.3	84.6
Electric milkers .....	Number :							
Per 100 farms .....	Number :	22	23	14	43	29	13	18
Average number of cows .....	Number :	22.2	11.3	5.1	17.7	19.3	5.7	11.9
Nonelectric milking, incl. hand .....	Number :	15	17	26	3	9	47	58
Per 100 farms .....	Number :	65	57	52	43	38	63	56
Average number of cows .....	Number :	2.3	1.9	2.5	1.3	2.4	2.3	2.3
Electric milk coolers .....	Number :							
Per 100 farms .....	Number :	4	---	---	14	---	---	1
Electric water heaters .....	Number :							
Per 100 farms .....	Number :	13	17	4	29	24	4	10
Lighting in poultry laying houses .....	Number :							
Per 100 farms .....	Number :	91	93	98	86	95	96	95
Average number of laying hens .....	Number :	26.7	11.7	4.6	14.9	8.1	11.7	11.2
Electric brooder hovers .....	Number :							
Per 100 farms .....	Number :	57	40	60	57	43	56	53
Electric brooder batteries .....	Number :							
Per 100 farms .....	Number :	17	20	2	---	10	12	11
Electric welders .....	Number :							
Per 100 farms .....	Number :	9	---	---	---	---	3	2

As a majority of poultry farms are in less favorable locations at some distance from cities (land classes 4 and 5), they did not report the availability of city water so frequently as was the case for dairy and cash-crop farms. A relatively large number reported one electrically operated water-pressure system; only a few of the farms, particularly the large farms, had two water-pressure systems. Of these, a lower proportion were electrically operated.

The use of electric farm appliances is of a relatively late date (table 29). Milk houses and poultry-laying houses were connected before 1935, whereas most of the milking machines and water heaters were installed since 1940. The use of lights in laying houses as well as the use of electric brooder hovers and batteries is also of more recent date.

Of major importance on individual farms are special electric appliances installed rather recently for which sufficient detail concerning size of appliance and extent of use was not obtained. Although the number of farms reporting such appliances was relatively small, in many cases they represent high consumption. In this category are such appliances as scalders and picking machines used on farms where production of fryers is important. On farms that specialize in production of eggs and that have a sufficient volume of production, special appliances for the grading and sorting of eggs are often found. Generally speaking, these are small as to size and consumption of power but are used daily. Rooms for grading and sorting eggs are usually in basements or other cool places. At times they require space heaters or fans, which represent greatly varying power loads on individual farms. Finally, the lighting of poultry houses to provide at least 13 hours of daylight was frequently found on farms that raised pullets for meat in addition to use in laying houses. Bulbs used in the lighting of poultry houses were often larger than is usually recommended.

These widely varying conditions made it difficult to apply standards of consumption of electricity based on use, so far as this could be ascertained. The estimated use of electricity in farm operations on poultry farms, as given in table 30, represents average kilowatt-hours per farm and has been prepared in the same way as those for dairy farms, using all available data on the extent of use. Obviously, for several appliances, some of which were previously mentioned, farmers were not in position to give accurate information as to the extent of use.

Estimated average annual consumption in farm operations on large poultry farms was 9,647 kilowatt-hours. Slightly more than 80 percent of this was used in connection with the poultry. Miscellaneous farm uses, particularly for supplementary irrigation of pastures and hay land, accounted for about 14 percent, with the remainder of approximately 5 percent used for a supplementary dairy enterprise. On medium-sized poultry farms, estimated farm use was considerably smaller. The proportions used for poultry and dairy purposes increased, but that for miscellaneous farm uses declined sharply. On small poultry farms, the predominant enterprise requires a relatively small amount of electricity. Because of insufficient use and only a small saving in labor, special poultry appliances such as are found on large poultry farms cannot be employed economically. Hand methods were not common. The dairy enterprise is also of minor significance with regard to consumption of power. General farm uses, on the other hand, became relatively more important, particularly the pumping of water. Electricity used for this purpose has been classified as farm use because on many of the farms in the area city water is available in the homes and any additional water is used primarily for the farms. Frequently, poultry farms that are not located within the radius of city water systems have their own water supplies and the pumping of water is for domestic and farm use. However, no attempt has been made here to estimate consumption of electricity separately for these uses of water.

Estimated home and farm uses of electricity are shown in figure 17 and table 30 (last 4 items). Of the total estimated use on poultry farms 64, 51, and 32 percent were used in farm operations on large, medium, and small farms, respectively. Because of greatly varying conditions from farm to farm and the difficulty of obtaining accurate data as to the extent of use, particularly of farm appliances, estimates of total annual use on poultry farms were not so close to actual reported use as was the case for other types of farms.

Table 29.- Percentage distribution of major farm buildings and appliances on poultry farms, by size of farm and period connected, northwestern Washington.

Item	Farms				Percentage connected								
	Size	Total	: Reporting date :		: Before 1935 :		: 1935-39 :		: 1940-44 :		: 1945-46 :		1947
			Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	
Milk house . . . . .	Large	23	2	100.0	---	---	---	---	---	---	---	---	
	Medium	30	3	66.7	---	---	---	---	---	---	---	---	
	Small	50	8	62.5	12.5	---	---	---	---	---	---	12.5	
	All	103	13	69.2	7.7	---	---	---	---	---	---	7.7	
Poultry laying house . . . . .	Large	23	13	69.2	15.4	---	---	---	---	---	---	---	
	Medium	30	20	40.0	30.0	---	---	---	---	---	---	5.0	
	Small	50	44	59.1	27.3	---	---	---	---	---	---	2.3	
	All	103	77	55.8	26.0	---	---	---	---	---	---	2.6	
Milking machine . . . . .	Large	23	5	---	---	---	---	---	---	---	---	---	
	Medium	30	7	---	---	---	---	---	---	---	---	14.3	
	Small	50	6	---	---	---	---	---	---	---	---	33.3	
	All	103	18	---	---	---	---	---	---	---	---	16.7	
Milk cooler . . . . .	Large	23	1	---	---	---	---	---	---	---	---	100.0	
	Medium	30	---	---	---	---	---	---	---	---	---	---	
	Small	50	---	---	---	---	---	---	---	---	---	---	
	All	103	1	---	---	---	---	---	---	---	---	100.0	
Water heater . . . . .	Large	23	2	---	---	---	---	---	---	---	---	---	
	Medium	30	5	---	---	---	---	---	---	---	---	40.0	
	Small	50	2	---	---	---	---	---	---	---	---	50.0	
	All	103	9	---	---	---	---	---	---	---	---	33.3	
Electric welder . . . . .	Large	23	1	---	---	---	---	---	---	---	---	100.0	
	Medium	30	---	---	---	---	---	---	---	---	---	---	
	Small	50	---	---	---	---	---	---	---	---	---	---	
	All	103	1	---	---	---	---	---	---	---	---	100.0	



Figure 15. Chicks have warmth under electric hovers. Good lighting speeds consumption of feed and water.



Figure 16. Night lighting of poultry houses increases production of eggs and meat.

Table 30.- Consumption of electricity per poultry farm, by size of farm, and by farm operations, northwestern Washington, 1947.

Item	Poultry farms 1/		
	Large	Medium	Small
	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.
Farm operations			
Dairy enterprise			
Milking machines . . . . .	138	77	25
Coolers . . . . .	137	---	---
Water heaters . . . . .	174	167	40
Lights and other . . . . .	25	23	21
Total . . . . .	474	267	86
Poultry enterprise			
Brooders . . . . .	4,370	1,635	634
Incubators . . . . .	1,100	53	5
Lighting, space heating, picking, water heating, etc. . . . .	2,400	1,185	142
Total . . . . .	7,870	2,873	781
Miscellaneous uses			
Farm equipment . . . . .	118	23	18
Farm shop . . . . .	36	12	8
Water pumping . . . . .	269	274	258
Irrigation . . . . .	830	---	60
Other lighting . . . . .	50	21	16
Total . . . . .	1,303	330	360
Total farm operations . . . . .	9,647	3,470	1,227
Farm household . . . . .			
Grand total . . . . .	5,520	3,375	2,550
Estimated . . . . .	15,167	6,845	3,777
Actual . . . . .	16,328	7,413	3,685

1/ Number of farms: Large, 23; Medium, 30; Small, 50.

#### Seasonal Variation in Consumption of Electricity

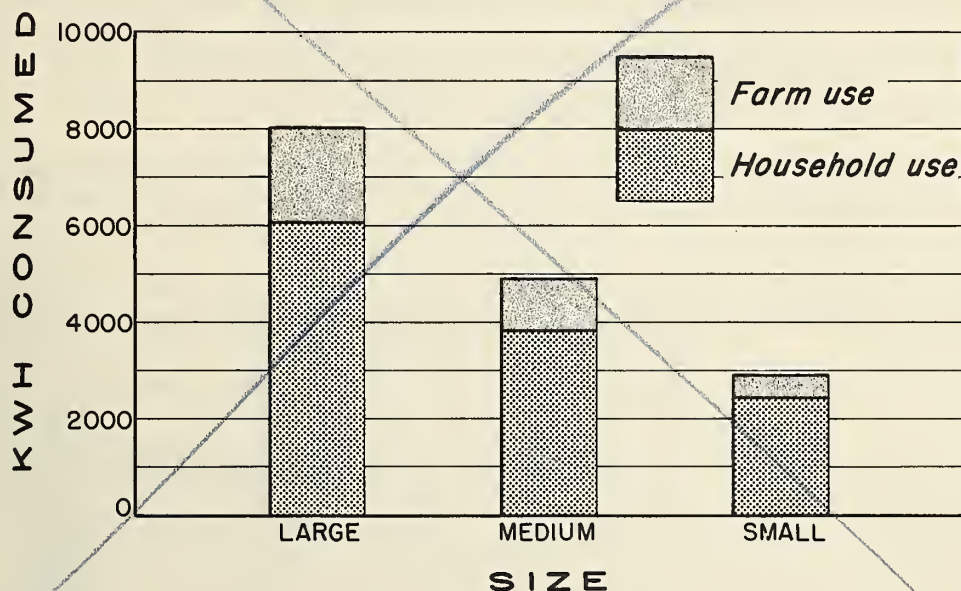
Poultry farms not only exceeded other types of farms in total consumption of electricity, especially for farm operations; they also had the greatest seasonal variation in use. Furthermore, the seasonal pattern of consumption, which is influenced primarily by the seasonality in production of poultry, is different.

Weighted average monthly consumption for poultry farms, as obtained from records of the supplier of electricity, is given in table 31. In 1941, actual consumption from January to June exceeded that in December. During these 6 months, it amounted to 60 percent of the total for the year. In 1947, consumption during each of the first 6 months of the year was smaller than that in December and, in total, amounted to only 54 percent of the annual consumption. On all other types of farms, consumption during the first half of the year is less than half of the total.

In order to make it comparable between the 2 years chosen and to be able to recognize the true seasonal distribution of consumption, actual monthly consumption must be corrected for growth during the year. The results of this adjustment were given in figure 9, page 31. Differences between the seasonal pattern in 1941 and 1947 may in large part be due to differences in weather conditions during these years. These differences affect

## ESTIMATED FARM AND HOUSEHOLD USES OF ELECTRICITY ON POULTRY FARMS BY SIZE OF FARM

(NORTHWESTERN WASHINGTON 1947)



U.S. DEPARTMENT OF AGRICULTURE

NEG. 47778-BUREAU OF AGRICULTURAL ECONOMICS

Figure 17. Poultry farms are the only type of farm on which consumption of electricity for farm uses is greater than that for household uses on large and medium-sized farms.

consumption of power on poultry farms to a considerably greater degree than they do consumption on other types of farms. However, in 1947, the increase in the load from poultry production started earlier in the fall and during the first few months of the year did not reach a level of consumption comparable with that in 1941. Furthermore, year-round production of poultry meat, more prominent in 1947, appears to have increased the consumption of electricity during the period of relatively low use from July to October.

The seasonal pattern of consumption was similar for various sizes of poultry farms. Small and medium-sized farms indicated a greater seasonal variation than large farms, on which year-round operation and greater diversification is more common.

### USE OF ELECTRICITY ON CASH-CROP FARMS

Cash-crop farms, it will be recalled, are located chiefly on productive land, have relatively high incomes, and are generally large. A variety of general types of cash crops and so-called specialty crops are grown. As the production and handling of these crops varies considerably, the opportunities to use electricity on the farm vary greatly. The types of cash crops grown and the methods of handling and storing in the area generally do not require much electricity. Perishable crops are sold immediately and, if not

marketed or processed in commercial plants, are stored in commercial facilities. Sorting, grading, cleaning, etc. of nonperishable crops are not commonly done on the farm or they require little electricity. All cash crops grown on contract are delivered immediately upon harvest, without grading, sorting, or cleaning.

Thus, the reasons for employing electricity in farming on cash-crop farms do not equal those on other major types in the area. But on cash-crop farms with supplementary enterprises the use of electricity is considerable. Dairy enterprises, to obtain a better utilization of the land resources, as well as of the byproducts from production of cash crops, are rather frequent on these farms. This increases the work on the farms considerably. The increase in the work, plus the seasonality of cash-crop production, particularly in an area such as the coastal region, and the financial ability to employ labor-saving devices, often lead to the use of electric appliances which on other types of farms would not be considered essential or economic.

Relatively high income on cash-crop farms is the main reason for the comparatively large use of electricity in the homes. When income is satisfactory, many home appliances are bought which are not essential even though convenient. They would not be purchased by farmers with a lower level of income.

Table 31.- Weighted average consumption of electricity on poultry farms, northwestern Washington, monthly 1941 and 1947 <sup>1/</sup>

Month	1941	1947
	Kilowatt-hours	Kilowatt-hours
January . . . . .	286	734
February . . . . .	304	705
March . . . . .	273	698
April . . . . .	313	785
May . . . . .	259	754
June . . . . .	291	608
July . . . . .	180	564
August . . . . .	162	508
September . . . . .	156	524
October . . . . .	169	599
November . . . . .	206	677
December . . . . .	258	841
Total . . . . .	2,857	7,997

<sup>1/</sup> Actual monthly consumption, not corrected for growth during the year.

#### Distribution of Farms in the Sample

The diversity of cash crops grown and the different supplementary enterprises on cash-crop farms, together with a somewhat limited number of cases, results in a frequency distribution by volume of electric consumption which, at least for large farms, makes average consumption less representative of the group.

Average consumption of electricity on large cash-crop farms in 1947 was 8,198 kilowatt-hours. Two major modes and one minor mode are apparent in the distribution of large farms according to power consumption. The lowest mode represents farms on which the production of cash crops is the sole farm enterprise. The two upper modes probably represent those farms on which livestock are an important part of the farm organization.

On medium-sized cash-crop farms the average consumption in 1947 amounted to 4,708 kilowatt-hours. This group is more homogeneous. Most of these farms have supplementary dairy enterprises of varying importance.

Table 32.- Persons living on farm, number and size of dwellings, and major electric and nonelectric home appliances on cash-crop farms, by size of farm and economic land use class, northwestern Washington, 1947.

Item	Size of farm			Land use			All farms
	Large	Medium	Small	Classes 1 and 2	Class 3	Classes 4 and 5	
	Number	Number	Number	Number	Number	Number	Number
Farms . . . . .	34	26	29	64	11	14	89
Persons per farm	5.2	3.6	3.3	4.1	4.7	3.6	4.1
Dwellings per farm . . . . .	1.7	1.2	1.1	1.4	1.4	1.1	1.4
Rooms per dwelling . . . . .	6.1	6.3	6.5	6.4	6.1	5.6	6.3
Home appliances							
Electric							
Percentage of farms reporting	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Ranges . . . . .	79.4	46.1	31.0	53.1	81.8	35.7	53.9
Water heaters	67.6	50.0	20.7	45.3	54.5	50.0	47.2
Refrigerators	94.1	92.3	79.3	87.5	100.0	85.7	88.8
Cabinet freezers . . .	8.8	7.7	---	7.8	---	---	5.6
Walk-in freezers . . .	11.8	---	---	4.7	---	7.1	4.5
Appliances per 100 farms	Number	Number	Number	Number	Number	Number	Number
Ranges . . . . .	85	46	34	58	82	36	57
Water heaters	79	50	21	52	55	50	52
Refrigerators	106	92	83	94	100	93	94
Cabinet freezers . . .	9	8	---	8	---	---	6
Walk-in freezers . . .	12	---	---	5	---	7	4
Nonelectric							
Percentage of farms reporting	Percent	Percent	Percent	Percent	Percent	Percent	Percent
Oil ranges . . . . .	14.7	15.4	34.5	21.9	9.1	28.6	21.3
Wood ranges . . . . .	14.7	38.5	31.0	29.7	18.2	21.4	27.0
Other ranges . . . . .	5.9	7.7	3.4	4.7	---	14.3	5.6
Other water heaters . . .	20.6	19.2	31.0	25.0	27.3	14.3	23.6
Appliances per 100 farms	Number	Number	Number	Number	Number	Number	Number
Oil ranges . . . . .	15	15	34	22	9	29	21
Wood ranges . . . . .	15	38	31	30	18	21	27
Other ranges . . . . .	12	8	3	5	---	14	8
Other water heaters . . .	21	19	31	25	27	14	24

Table 33.- Percentage distribution of major home electric appliances on cash-crop farms, by size of farm and period connected, northwestern Washington.

Electric appliance	Farms			Percentage connected				
	Size	Total	Reporting	Before	1935-	1940-	1945-	1947
			date	1935	39	44	46	
			connected:					
		Number	Number	Percent	Percent	Percent	Percent	Percent
Range . . . . .	Large	34	26	15.4	23.1	30.7	15.4	15.4
	Medium	26	11	18.2	9.1	36.3	9.1	27.3
	Small	29	8	12.5	12.5	25.0	50.0	---
	All	89	45	15.6	17.8	31.0	20.0	15.6
Refrigerator . . . . .	Large	34	31	6.4	38.8	35.5	16.1	3.2
	Medium	26	22	9.1	27.3	31.8	22.7	9.1
	Small	29	23	4.3	43.5	26.1	21.7	4.3
	All	89	76	6.6	36.8	31.6	19.7	5.3
Water heater . . . . .	Large	34	21	9.5	14.3	28.6	38.1	9.5
	Medium	26	11	9.1	---	45.4	18.3	27.2
	Small	29	6	16.7	---	16.7	33.3	33.3
	All	89	38	10.5	7.9	31.6	31.6	18.4

Table 34.- Estimated consumption of electricity in farm households on cash-crop farms, by size of farm and by appliances, northwestern Washington, 1947.

	Cash-crop farms 1/							
	Average :		Large		Medium		Small	
	consump- tion :		Units :		Units :		Units :	
	per unit :		reported :		consumed :		reported :	
	Kw.-hrs.	No.	Kw.-hrs.	No.	Kw.-hrs.	No.	Kw.-hrs.	No.
Lighting . . . . .	300	59	17,700	32	9,600	31	9,300	
Blankets . . . . .	50	7	210	5	150	3	90	
Broilers . . . . .	100	9	900	1	100	1	100	
Clocks . . . . .	20	46	920	27	540	23	460	
Dishwashers . . . . .	30	3	90	1	30	---	---	
Exhaust fans . . . . .	30	9	270	2	60	---	---	
Food mixers . . . . .	15	21	315	17	255	10	150	
Cabinet freezers . . . . .	900	3	2,700	2	1,800	---	---	
Walk-in freezers . . . . .	1,800	4	7,200	---	---	---	---	
Heating pads . . . . .	12	18	216	6	72	13	156	
Hot-air circ. fan . . . . .	25	11	275	10	250	11	275	
Hot-water pumps . . . . .	180	---	---	1	180	---	---	
Hot plates . . . . .	100	26	2,600	18	1,800	19	1,900	
Irons . . . . .	75	40	3,000	26	1,950	29	2,175	
Ironers . . . . .	120	4	480	4	480	3	360	
Oil furnaces . . . . .	250	7	1,750	4	1,000	5	1,250	
Percolators . . . . .	80	17	1,360	11	880	13	1,040	
Radios . . . . .	100	63	6,300	36	3,600	38	3,800	
Electric ranges . . . . .	1,350	29	39,150	12	16,200	10	13,500	
Refrigerators . . . . .	400	36	14,400	24	9,600	24	9,600	
Roasters . . . . .	300	3	900	2	600	2	600	
Sewing machines . . . . .	10	9	90	6	60	6	60	
Space heaters . . . . .	240	14	3,360	6	1,440	9	2,160	
Toasters . . . . .	45	36	1,620	20	900	22	990	
Vacuum cleaners . . . . .	15	37	555	18	270	22	330	
Waffle irons . . . . .	25	31	775	20	500	25	625	
Washing machines . . . . .	30	36	1,080	22	660	27	810	
Electric-water heater . . . . .	3,600	27	97,200	13	46,800	6	21,600	
Other . . . . .		2	45	---	---	1	40	
Total . . . . .			205,461		99,777		71,371	
Average per farm . . . . .			6,043		3,838		2,461	

1/ Number of farms: Large, 34; Medium, 26; Small, 29.

Average consumption on small cash-crop farms was 3,469 kilowatt-hours in 1947. A considerable number of farms reported lower consumption--on 56 percent it was less than 2,000 kilowatt-hours. Dairying is less frequent in this size group but a higher proportion, particularly those producing strawberries or caneberries, have small herds.

### Use of Electricity in Households

On the average for each type of farm, the number and sizes of farm dwellings are larger on cash-crop farms than on other types of farms in the area. The average number of persons living on cash-crop farms, however, is slightly smaller than those on dairy farms. Partly because of more and larger dwellings, the number of home appliances reported by cash-crop farmers and, consequently, the consumption of electricity for home use, is larger than on other farms. Farm income has been mentioned as one of the main factors influencing the extent of home consumption on cash-crop farms. This contention is based on the fact that the percentage of cash-crop farms reporting major home appliances is larger than for other types. Almost 54 percent of all cash-crop farms (table 32 and table 66, page 102) reported electric ranges, 47 percent reported water heaters, and 89 percent reported refrigerators. Cabinet and walk-in freezers are also found somewhat more frequently on cash-crop farms. Of the nonelectric home appliances, only oil ranges were reported in larger number than on other types of farms.

The proportion of cash-crop farms reporting major electric home appliances is indicated in table 32 by size of farm and economic land use class. Except for medium-sized dairy farms, large and medium sizes of cash-crop farms exceeded the same size groups of other types in the number of major home appliances reported. A larger proportion of medium-sized dairy farms reported electric ranges. The decline in the proportion of farms reporting major home appliances from medium to small farms is somewhat larger on cash-crop farms than on other types, particularly for water heaters and refrigerators. Thus, a relatively smaller number of small cash-crop farms reported them.

The year of connection with electricity of major home appliances also differs somewhat from that on other types of farms (table 33). Generally speaking, ranges, refrigerators, and water heaters were connected during earlier periods on cash-crop farms. A large proportion of refrigerators even on small farms were connected before 1940. A third of the electric ranges, but only 18 percent of the water heaters, were connected earlier. Electric ranges preceded water heaters on cash-crop farms, while on other types of farms they were connected at approximately the same time as water heaters. For most of the home appliances, large farms reported an earlier date of connection than medium-sized farms which, in turn, were ahead of small farms.

Estimated consumption of electricity in farm households on cash-crop farms is given in table 34. Average consumption was 6,043 kilowatt-hours on large farms, 3,838 kilowatt-hours on medium farms, and 2,461 kilowatt-hours on small farms. Except for small sizes of cash-crop farms on which the consumption of power in the homes is smaller than on dairy or poultry farms, home consumption of this type of farm exceeds that of other types in the area.

### Use of Electricity in Farm Operations

It has been pointed out that the type of cash-crop production in northwestern Washington and the methods of handling the crop after harvest offer little opportunity for using electricity. Unless other enterprises are conducted on cash-crop farms, use of electricity in the farming is extremely small.

As indicated in table 35 by the number of farms reporting dairy barns and milk and poultry houses, a large number of cash-crop farms have at least some of the facilities

Table 35.- Number and percentage electrified of farm buildings and major farm appliances on cash-crop farms, by size of farm and economic land use, northwestern Washington, 1947

Item	Unit	Size of farm			Land use			All farms
		Large	Medium	Small	Classes 1 and 2	Class 3	Classes 4 and 5	
Farms	Number	34	26	29	64	11	14	89
Dairy barns								
Per 100 farms	Number	62	50	28	56	36	14	47
Percentage connected	Percent	85.7	92.3	100.0	88.9	100.0	100.0	90.5
General barns								
Per 100 farms	Number	68	77	66	73	64	57	70
Percentage connected	Percent	95.6	100.0	100.0	97.9	100.0	100.0	98.4
Milk houses								
Per 100 farms	Number	44	62	34	52	64	7	46
Percentage connected	Percent	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Poultry laying houses								
Per 100 farms	Number	62	42	59	56	55	50	55
Percentage connected	Percent	71.4	81.8	94.1	80.5	66.7	100.0	81.6
Poultry brooder houses								
Per 100 farms	Number	18	23	3	14	9	21	15
Percentage connected	Percent	66.7	83.3	100.0	66.7	100.0	100.0	76.9
Farm shops								
Per 100 farms	Number	74	46	34	56	45	43	53
Percentage connected	Percent	92.0	83.3	90.0	86.1	100.0	100.0	89.4
Yard lights								
Per 100 farms	Number	71	58	48	61	64	50	60
City water supply								
Per 100 farms	Number	71	77	79	91	73	7	75
One water pressure system								
Per 100 farms	Number	44	58	90	53	82	93	63
Percentage connected	Percent	100.0	100.0	80.8	85.3	100.0	100.0	91.1
Second water pressure system								
Per 100 farms	Number	6	---	---	---	9	7	2
Percentage connected	Percent	100.0	---	---	---	100.0	100.0	100.0
Electric milkers								
Per 100 farms	Number	44	58	28	53	27	7	43
Average number of cows	Number	22.7	9.9	6.4	15.7	4.7	8.0	14.6
Nonelectric milking, incl. hand	Number	7	9	9	18	2	5	25
Per 100 farms	Number	20.5	34.6	31.0	28.1	18.1	35.7	28.0
Average number of cows	Number	2.4	3.3	2.0	2.4	4.0	2.6	2.6
Electric milk coolers								
Per 100 farms	Number	9	---	---	5	---	---	3
Electric water heaters								
Per 100 farms	Number	35	42	14	41	9	---	30
Lighting in poultry laying houses								
Per 100 farms	Number	27	19	35	23	18	50	27
Average number of laying hens	Number	37.7	97.3	56.1	39.7	200.0	70.0	61.1
Electric brooder hovers								
Per 100 farms	Number	9	8	14	9	---	21	10
Electric brooder batteries								
Per 100 farms	Number	---	---	---	---	---	---	---
Electric welders								
Per 100 farms	Number	6	12	7	11	---	---	8

needed for supplementary enterprises, even though these enterprises may now be small. Reasons for this lie in the fact that the area originally was almost exclusively a dairy- and poultry-producing area and that production of cash crops is relatively recent. Many of the cash-crop farms can return to dairy or poultry production should conditions so dictate. Some have already done so, continuing the production of cash crops on a very small scale or discontinuing it altogether.

In size the dairy enterprise on cash-crop farms compares well with that on poultry farms, but a higher proportion uses electric milkers (table 67, page 103). The number of farms which report milk cows and which do not use electric milkers is comparatively small. As the size of a supplementary poultry enterprise on cash-crop farms is considerably smaller than that on dairy farms, fewer specialized poultry appliances were reported. Electric welders were reported somewhat more frequently on cash-crop farms,

Table 36.- Percentage distribution of major electrified farm buildings and appliances on cash-crop farms, by size of farm and period connected, northwestern Washington.

Item	Farms									
	Size	Total	Reporting date		Before 1935		Percentage connected			
			Number	Percent	Percent	Percent	1935-39	1940-44	1945-46	1947
Milk house . . . . .	Large	34	14	92.9	7.1	---	---	---	---	---
	Medium	26	15	60.0	26.6	6.7	---	---	---	6.7
	Small	29	9	77.8	22.2	---	---	---	---	---
	All	89	38	76.4	18.4	2.6	---	---	---	2.6
Poultry-laying house . . . . .	Large	34	12	83.4	8.3	8.3	---	---	---	---
	Medium	26	7	71.4	14.3	14.3	---	---	---	---
	Small	29	14	71.4	14.3	7.2	---	---	---	7.1
	All	89	33	75.8	12.1	9.1	---	---	---	3.0
Milk ing machine . . . . .	Large	34	15	46.6	6.7	20.0	20.0	20.0	20.0	6.7
	Medium	26	14	21.4	14.3	28.6	14.3	14.3	14.3	21.4
	Small	29	8	25.0	37.5	25.0	---	---	---	12.5
	All	89	37	32.5	16.2	24.3	13.5	13.5	13.5	13.5
Milk cooler . . . . .	Large	34	2	---	---	---	---	---	---	100.0
	Medium	26	1	---	---	---	100.0	---	---	---
	Small	29	---	---	---	---	---	---	---	---
	All	89	3	---	---	---	33.3	---	---	66.7
Water heater . . . . .	Large	34	12	41.6	16.7	33.3	8.4	---	---	---
	Medium	26	11	9.0	27.3	27.3	18.2	18.2	18.2	18.2
	Small	29	4	---	---	75.0	---	---	---	25.0
	All	89	27	22.2	18.5	37.1	11.1	11.1	11.1	11.1
Electric welder . . . . .	Large	34	2	---	50.0	---	50.0	---	---	---
	Medium	26	2	---	---	---	50.0	---	---	50.0
	Small	29	1	---	---	100.0	---	---	---	---
	All	89	5	---	20.0	20.0	40.0	40.0	40.0	20.0

but they are not likely to be numerous in an area that is well supplied with commercial facilities.

Most of the cash-crop farms are located within the radius of city water systems and the majority have city water supply. Water-pressure systems on these farms were found primarily in the less favorable locations and on relatively small farms.

The year of wiring farm buildings and using electricity with the major farm appliances on cash-crop farms, in line with the connection of home appliances, was, generally speaking, earlier than on other types of farms. Even small farms reported early connection of farm buildings and farm appliances. This may be due primarily to their location in the vicinity of or between major load centers. The percentage of farm buildings and farm appliances connected during specified periods is given in table 36.

Table 37.- Consumption of electricity per cash-crop farm, by size of farm and by farm operations, northwestern Washington, 1947.

Item	Cash-crop farms <sup>1/</sup>		
	Large	Medium	Small
	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.
Farm operations			
Dairy enterprise			
Milking machine . . . . .	282	285	53
Cooler . . . . .	175	54	---
Water heater . . . . .	529	438	155
Light and other . . . . .	124	42	24
Total . . . . .	1,110	819	232
Poultry enterprise			
Brooder . . . . .	294	42	28
Incubator . . . . .	---	---	---
Light and other . . . . .	3	4	4
Total . . . . .	297	46	32
Miscellaneous uses			
Farm equipment . . . . .	97	66	22
Farm shop . . . . .	33	32	20
Water pumping . . . . .	112	77	114
Irrigation . . . . .	260	---	---
Other lighting . . . . .	65	39	23
Total . . . . .	567	214	179
Total farm operations . . . . .	1,974	1,079	443
Farm household			
Grand total . . . . .	6,043	3,838	2,461
Estimated . . . . .	8,017	4,917	2,904
Actual . . . . .	8,198	4,708	3,469

<sup>1/</sup> Number of farms: Large, 34; Medium, 26; Small, 29.

Estimated consumption of electricity in farm operations on cash-crop farms is given in table 37. Well over half of the farm use of electricity--for medium-sized farms more than three-fourths--was for supplementary dairy enterprises. Consumption for poultry enterprises and miscellaneous farm uses was minor.

Combined estimates of farm and home use of electricity in 1947, as given in table 37 and figure 18, do not compare closely with actual use as reported for that year. Estimates based on the same standards as for other types of farms are inadequate for small cash-crop farms. Estimates for other types of farms were reasonably close for all three size groups, and the reason for the discrepancy in estimated and actual use is expected to lie in certain less common uses not reported or in a considerably greater than average consumption for the appliances in use on farms in this group. Further examination revealed no other reasons for this discrepancy.

### Seasonal Variation in Consumption

The seasonal pattern of power consumption on cash-crop farms is influenced primarily by large household use except for the summer peak in July or August, which is probably caused by consumption for supplementary irrigation on large farms.

Variation in monthly use between 1941 and 1947 (table 38 and figure 18, page 69 ) appears to be the result of differences in weather between the 2 years rather than differences in the type of appliances in use.

Table 38.- Weighted average consumption of electricity on cash-crop farms, northwestern Washington, monthly 1941 and 1947 <sup>1/</sup>

Month	1941	1947
	Kilowatt-hours	Kilowatt-hours
January . . . . .	319	585
February . . . . .	278	567
March . . . . .	275	486
April . . . . .	275	475
May . . . . .	275	506
June . . . . .	278	516
July . . . . .	269	565
August . . . . .	302	563
September . . . . .	264	513
October . . . . .	239	518
November . . . . .	310	573
December . . . . .	321	600
Total . . . . .	3,405	6,467

<sup>1/</sup> Actual monthly consumption, not corrected for growth during the year.

### USE OF ELECTRICITY ON PART-TIME FARMS

Located in the area, with a somewhat heavier concentration near urban centers, are a relatively large number of part-time farms, which derive most of the family income from off-farm sources. Major emphasis was placed upon the use of electricity on commercial-type farms in the main part of the area, and only a few records were obtained for part-time farms scattered throughout the area. Farming operations on these farms are so small that they can be carried on by the man of the family at odd times or by members of the family. Income from farming is small; production often does not greatly exceed the quantity used in the household. Off-farm income varies with opportunities for employment but in many instances it has been substantial.

Average consumption on these farms was 2,286 kilowatt-hours, most of which was consumed in the household.

Use of Electricity in Households and Farm Operations

The average number of persons living on part-time farms was somewhat larger than the average on small farms of the major commercial types, but size of dwelling was about the same (table 39). More refrigerators were reported than on small commercial farms, but the number of farms reporting electric ranges and water heaters was smaller (table 68, page 104). Nonelectric home appliances were found in similar proportion as on small farms.

Refrigerators were connected somewhat earlier than other major electric home appliances, the majority of which were connected during the war. Electric water heaters are an exception as most of these were bought after the war (table 40).

Table 39.- Persons living on farm, number and size of dwellings, and major electric and nonelectric home appliances on part-time farms, by economic land use class, northwestern Washington.

Item	Land use			All farms
	Classes	Class	Classes	
	1 and 2	3	4 and 5	
	Number	Number	Number	Number
Farms . . . . .	8	8	26	42
Persons per farm . . . . .	4.1	3.2	3.6	3.6
Dwellings per farm . . . . .	1.1	1.0	1.0	1.0
Rooms per dwelling . . . . .	6.0	6.6	5.8	6.0
Home appliances				
Electric				
Percentage of farms reporting	Percent	Percent	Percent	Percent
Ranges . . . . .	37.5	---	19.2	19.0
Water heaters . . . . .	37.5	25.0	15.4	21.4
Refrigerators . . . . .	100.0	100.0	73.1	83.3
Cabinet freezers . . . . .	12.5	---	---	2.4
Walk-in freezers . . . . .	---	---	---	---
Appliances per 100 farms	Number	Number	Number	Number
Ranges . . . . .	38	---	19	19
Water heaters . . . . .	38	25	15	21
Refrigerators . . . . .	100	100	73	83
Cabinet freezers . . . . .	12	---	---	2
Walk-in freezers . . . . .	---	---	---	---
Nonelectric				
Percentage of farms reporting	Percent	Percent	Percent	Percent
Oil ranges . . . . .	37.5	37.5	7.7	19.0
Wood ranges . . . . .	25.0	37.5	42.3	38.1
Other ranges . . . . .	---	25.0	30.8	23.8
Other water heaters . . . . .	12.5	25.0	50.0	38.1
Appliances per 100 farms	Number	Number	Number	Number
Oil ranges . . . . .	38	38	8	19
Wood ranges . . . . .	25	38	46	40
Other ranges . . . . .	---	25	31	24
Other water heaters . . . . .	12	25	50	38

Table 40.- Percentage distribution of major home electric appliances on part-time farms, by period connected, northwestern Washington.

Electric appliance	Farms			Percentage connected				
	Size	Total	Reporting date connected	Before 1935	1935-	1940-	1945-	1947
					39	44	46	
		Number	Number	Percent	Percent	Percent	Percent	Percent
Range . . . . .	Small	42	8	---	12.5	50.0	25.0	12.5
Refrigerator . . .	Small	42	33	---	33.3	36.4	18.2	12.1
Water heater . . .	Small	42	9	---	11.1	11.1	55.6	22.2

Table 41.- Estimated consumption of electricity in farm households on part-time farms, by appliances, northwestern Washington, 1947.

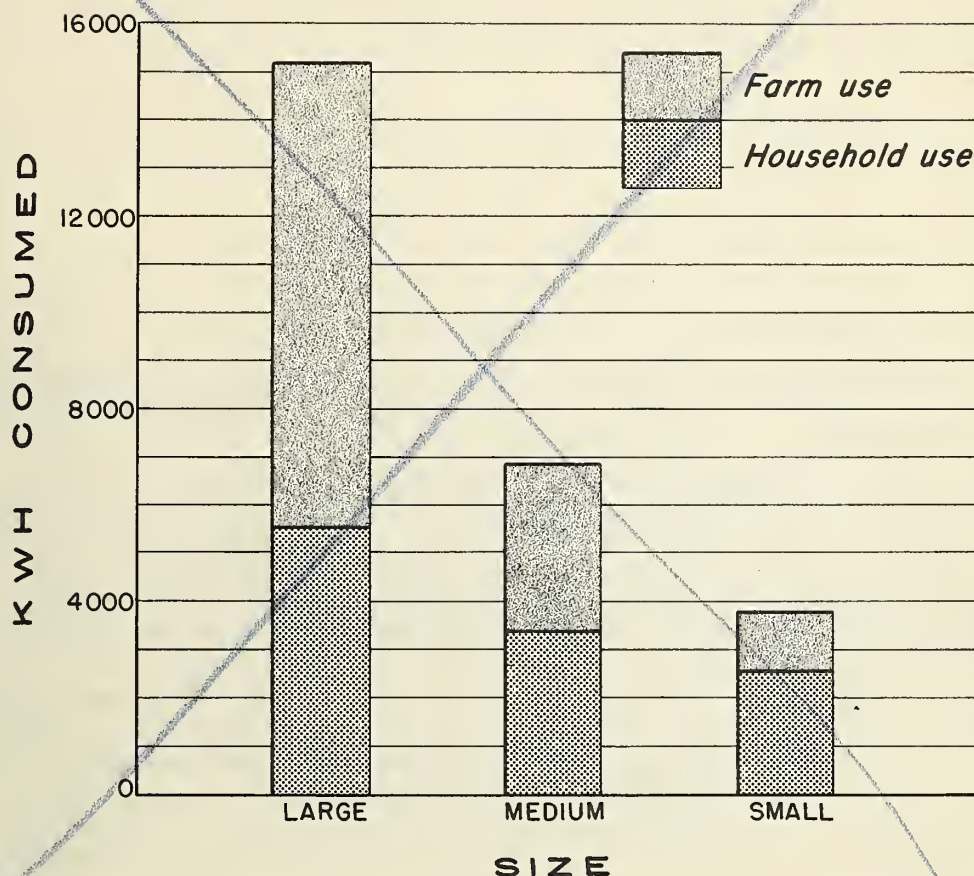
Item	Average : consump- tion : per unit		Part-time farms 1/ Small Units : Quantity reported : consumed	
	Kw.-hrs.		No.	Kw.-hrs.
Lighting . . . . .	300		44	13,200
Blankets . . . . .	30		3	90
Broilers . . . . .	100		1	100
Clocks . . . . .	20		36	720
Dishwashers . . . . .	30		---	---
Exhaust fans . . . . .	30		---	---
Food mixers . . . . .	15		19	285
Cabinet freezers . . . . .	900		1	900
Walk-in freezers . . . . .	1,800		---	---
Heating pads . . . . .	12		19	228
Hot-air circ. fans . . . . .	25		9	225
Hot-water pumps . . . . .	180		---	---
Hot plates . . . . .	100		31	3,100
Irons . . . . .	75		43	3,225
Ironers . . . . .	120		6	720
Oil furnaces . . . . .	250		4	1,000
Percolators . . . . .	80		19	1,520
Radios . . . . .	100		62	6,200
Electric ranges . . . . .	1,350		8	10,800
Refrigerators . . . . .	400		35	14,000
Roasters . . . . .	300		3	900
Sewing machines . . . . .	10		8	80
Space heaters . . . . .	240		9	2,160
Toasters . . . . .	45		26	1,170
Vacuum cleaners . . . . .	15		20	300
Waffle irons . . . . .	25		32	800
Washing machines . . . . .	30		40	1,200
Electric-water heaters . . . . .	3,600		9	32,400
Total . . . . .				95,323
Average per farm . . . . .				2,270
1/ Number of farms: Small, 42.				

Table 42.-Number and percentage electrified of farm buildings and major farm appliances on part-time farms, by economic land use, northwestern Washington, 1947

Item	Unit	Land use			All farms
		Classes : 1 and 2 :	Class : 3	Classes : 4 and 5 :	
Farms . . . . .	Number	8	8	26	42
Dairy barns					
Per 100 farms . . . . .	Number	75	75	42	55
Percentage connected . . . . .	Percent	100.0	83.3	100.0	95.6
General barns					
Per 100 farms . . . . .	Number	63	38	50	50
Percentage connected . . . . .	Percent	100.0	66.7	100.0	95.2
Milk houses					
Per 100 farms . . . . .	Number	63	88	27	45
Percentage connected . . . . .	Percent	100.0	71.4	100.0	89.5
Poultry laying houses					
Per 100 farms . . . . .	Number	88	88	77	81
Percentage connected . . . . .	Percent	95.7	71.4	95.0	88.2
Poultry brooder houses					
Per 100 farms . . . . .	Number	25	13	8	12
Percentage connected . . . . .	Percent	100.0	100.0	100.0	100.0
Farm shops					
Per 100 farms . . . . .	Number	63	63	35	45
Percentage connected . . . . .	Percent	100.0	40.0	88.9	78.9
Yard lights					
Per 100 farms . . . . .	Number	88	88	42	60
City water supply					
Per 100 farms . . . . .	Number	75	13	19	29
One water pressure system					
Per 100 farms . . . . .	Number	63	88	73	74
Percentage connected . . . . .	Percent	80.0	100.0	100.0	96.8
Second water pressure system					
Per 100 farms . . . . .	Number	---	---	4	2
Percentage connected . . . . .	Percent	---	---	100.0	100.0
Electric milkers					
Per 100 farms . . . . .	Number	50	63	27	38
Average number of cows . . . .	Number	5.5	5.4	6.4	5.9
Nonelectric milking, incl. hand	Number	4	2	14	20
Per 100 farms . . . . .	Number	50	25	54	48
Average number of cows . . . .	Number	3.0	4.5	3.1	3.2
Electric coolers					
Per 100 farms . . . . .	Number	---	---	---	---
Electric water heaters					
Per 100 farms . . . . .	Number	13	13	---	5
Lighting in poultry laying houses					
Per 100 farms . . . . .	Number	50	50	54	52
Average number of laying hens	Number	50.0	61.7	110.0	86.4
Electric brooder hovers					
Per 100 farms . . . . .	Number	13	13	15	14
Electric brooder batteries					
Per 100 farms . . . . .	Number	13	---	---	2
Electric welders					
Per 100 farms . . . . .	Number	---	---	4	2

# ESTIMATED FARM AND HOUSEHOLD USES OF ELECTRICITY ON CASH-CROP FARMS, BY SIZE OF FARM

(NORTHWESTERN WASHINGTON 1947)



U.S. DEPARTMENT OF AGRICULTURE

NEG. 47779-BUREAU OF AGRICULTURAL ECONOMICS

Figure 18. Cash-crop farms had a high consumption of electricity in the farm households whereas farm uses were comparatively slight.

Consumption of electricity in the household is estimated in table 41 in the same way as for other types of farms. On this basis, consumption in the household accounted for almost all of the consumption of electricity on part-time farms. Apparently, part-time farms did not use home appliances to the extent that they were used on other types of farms.

Farm use of electricity is insignificant, even though a considerable number reported keeping cows and poultry, but not enough to make the use of electric appliances economical. Poultry was more common than dairy enterprises. The average size of laying flock was less than 100 hens and the average number of milk cows was less than 6.

Table 43. - Percentage distribution of major electrified buildings and appliances on part-time farms, by period connected, northwestern Washington

Item	Farms			Percentage connected				
	Size	Total	Reporting date connected	Before 1935	1935-39	1940-44	1945-46	1947
		Number	Number	Percent	Percent	Percent	Percent	Percent
Milk house . . . . .	Small	42	14	57.2	7.1	---	28.6	7.1
Poultry laying house	Small	42	23	56.5	8.7	17.4	4.3	13.1
Milking machine . . .	Small	42	16	6.2	18.8	6.2	56.3	12.5
Milk cooler . . . . .	Small	42	---	---	---	---	---	---
Water heater . . . . .	Small	42	2	50.0	---	---	50.0	---
Electric welder . . . .	Small	42	1	---	---	---	100.0	---

Lighting in poultry-laying houses was reported on more than half of the farms (table 42), while slightly more than a third reported electric milkers in use (table 69, page 105). Almost half of all part-time farms reporting cows did not use electric milkers. The average number of cows on these farms was slightly over three. It is apparent from these data that a comparatively large number of farms have electric farm appliances, but their use in 1947 was small; in fact, some operators did not use them at all.

The wiring of farm buildings on part-time farms occurred after about the same lapse of time as on the major commercial types of small size (table 43). Milking machines, except for comparatively few connected before the war, were bought primarily after the war.

Table 44.-Weighted average consumption of electricity on part-time farms, northwestern Washington, monthly 1941 and 1947 <sup>1/</sup>

Month	1941	1947
	Kilowatt-hours	Kilowatt-hours
January . . . . .	70	199
February . . . . .	62	219
March . . . . .	55	209
April . . . . .	60	175
May . . . . .	62	173
June . . . . .	56	172
July . . . . .	55	166
August . . . . .	59	172
September . . . . .	60	181
October . . . . .	63	184
November . . . . .	63	200
December . . . . .	69	210
Total . . . . .	734	2,260

<sup>1/</sup> Actual monthly consumption, not corrected for growth during the year.

Thus, in many respects, part-time farms present a different situation from that on major commercial farms. The size of farming operations is smaller than on any commercial-type farms but relatively more electric appliances are operated. Time-saving in farm work because of outside work appears to seem more important and income from off-farm sources permits the purchase and maintenance of appliances which operators of small commercial farms cannot buy or do not feel justified in buying.

### Seasonal Variation in Consumption of Electricity

The small amount of electricity used in farming (table 44) suggests that the seasonal pattern of use of electricity is primarily influenced by household use and for this reason it should compare with consumption for urban residential users.

Differences in the seasonal pattern between 1941 and 1947 are noticeable only during the early part of the year. They appear to be caused chiefly by differences in weather rather than by a change in the kind and extent of use of certain appliances.

### FARMERS' EXPERIENCES IN USE OF ELECTRICITY

The over-all power situation in the Pacific Northwest and the general kind of experiences of rural customers, particularly those in the fringe areas as compared with areas of a more concentrated load, are reflected in the replies of farmers to several questions regarding their experience in the use of electricity. A majority felt that the service had been satisfactory. When service was not considered satisfactory, farmers mentioned low voltage as the reason.

Experience of farmers with low voltage was not unique during the year 1947, as similar conditions were reported in many other areas. The primary reason lies in the rapid increase in demand for electricity and the inability of distributors to obtain and install the needed equipment. During and after the war, a large backlog of orders accumulated; then rapid increases in consumption forced the placing of new orders at an accelerated rate. On the other hand, farmers have added appliances often with little regard to the adequacy of the wiring system on the farmstead. The use of electricity in excess of what the farm wiring was designed to carry in some cases may have been the reason for the low-voltage conditions they experienced. While low voltage was fairly common, a larger proportion of the heavy users of electricity mentioned this difficulty than was true for small farms which generally use moderate amounts of electricity.

In 1947 interruptions in service were minor in both extent and character. Only 10 percent of all farmers reported interruptions; some of them stated that they had been more frequent during the war than in later years. In the postwar years, larger transformers were installed as soon as they became available, and this brought considerable improvement in service. Losses due to interruptions or to low voltage were reported by 5 percent of all farmers. In most cases, motors of less than one horsepower used on pumps, milking machines, freezer units, power saws, or for multiple purposes, burned out. Other losses consisted of the dying of fryers, a drop in egg production, burning out of motor brushes, and loss in time or similar, more or less minor, inconveniences.

Despite these losses, farmers in general said they considered electricity reliable for all purposes for which electricity or electric appliances are adapted. Some mentioned ranges and water heaters as home appliances for which they felt electricity was not reliable; among the farm appliances, milking machines, brooders, and incubators were mentioned. Only 4 percent of the interviewed farmers maintained some kind of standby equipment. In most cases this did not involve additional investment, as it consisted of items that had been replaced through the purchase of electric appliances. Gas motors for milking machines and oil stoves for brooders were the more common kinds of standby equipment.

Almost a third of the farmers thought that available electric power had limited their use of electricity. In the homes the chief uses or appliances affected were ranges, water heaters, and flatirons. Among the farm appliances, milking machines, brooders, and lights were most frequently mentioned. Fear of overloading transformers and wiring had induced them to restrict the use of electricity, particularly during peak periods. Assuming a greater capacity of present facilities, farmers would first increase their present uses, according to their replies. A considerable number, however, would get additional electric appliances. The proportions of home and farm appliances which farmers said they intend to install under more satisfactory conditions of power supply are shown in table 45.

Table 45.- Appliances farmers reported they would install if more electric power were available, northwestern Washington.

Item	Appliances per 100 farms	Item	Appliances per 100 farms
	Number		Number
Home appliances		Farm appliances	
Ranges . . . . .	7	Welders . . . . .	2
Water heaters . .	6	Motors . . . . .	1
Walk-in freezers	3	Milking machines .	1
Deep freezers . .	1	Water heaters . . .	1/
Refrigerators . .	1	Brooders . . . . .	1/
House heating . .	1/	Refrigerators in	
		barn . . . . .	1/
		Sawmills . . . . .	1/
		Shop equipment . .	1/
		Irrigation pumps .	1/

1/ Less than 0.5 per 100 farms.

According to these intentions, home appliances, all of which are heavy users of electricity, would be installed in greater proportion than farm appliances. The latter are not so numerous nor would they involve, in most cases, a high or continuous use as in the case of home appliances. There appeared to be considerable interest in refrigeration or freezing equipment among farmers in this relatively densely populated area whose farms are within reasonable distance of commercial locker plants. On the average of all farms, locker plants were located within 3 to 4 miles of the farm and 81 percent of the interviewed farmers rented lockers. With regard to types and sizes of farms, the renting of lockers was more common among large and medium sizes and among dairy and part-time farms than among small farms or other types.

### SUMMARY AND OUTLOOK

Although they are predominantly of a dairy-farming type, farms in this area vary considerably in type of organization and size of operations. Except insofar as they affect income, the type and size of operation do not greatly influence consumption of electricity in farm households, but they do determine the extent to which electricity may be used in farming operations.

Information indicates that, in 1947, electricity had been available in the area for 20 years or more and that most of the farms had been connected to power lines for that length of time. This suggests that the length of time the service has been available has had very little influence upon the amount of electricity now consumed on individual farms.

The rate of increase in consumption of electricity on farms in the area during the last 10 years was considerably greater than that for all residential consumers in the State of Washington and the Nation as a whole. Although, in 1938, the average consumption on farms was almost one-fourth below the average for all residential consumers in the State, by 1947 it exceeded this average by more than 10 percent. Both average consumption of electricity on farms and average consumption by all residential users in the State greatly exceeded the average for the country.

In 1938, average consumption on farms in the area was somewhat more than 1,000 kilowatt-hours and by 1947 it had risen to well over 4,000 kilowatt-hours. Large farms or farms that had considerable opportunity for the use of electricity, which, in 1938, had already attained a fairly high level of consumption, by 1947 had increased consumption more in absolute terms but they were behind the small farms and those limited in opportunity in the rate of increase during the 10-year period. The addition of a few appliances on farms where electricity was used primarily for lighting had resulted in a proportionately larger increase in consumption. Also, farms in more productive locations (land use classes 1 and 2) which were generally larger and had higher incomes, increased consumption more in terms of kilowatt-hours, but they had a lower rate of increase than did farms in less favorable locations.

The kind of tenure of farms (whether owner-operated, part-owner, or tenant-operated) apparently has influenced the level of consumption of electricity or the rate of growth very little, if at all.

The level of consumption of electricity reached on farms by 1947--more than 4,000 kilowatt-hours per farm--amounted to 120 kilowatt-hours for each acre in crops or plowable pastures. Consumption per acre was highest on small farms, poorly located, and on those having large opportunities to use electricity. The relatively large proportion of use in farm households and the types and sizes of farms predominating on various land use classes are the main factors that affect consumption per acre of land in crops.

Size of enterprise predominating on a given farm is not so good a measure of consumption of electricity as income. No consideration is given to supplementary enterprises and very few farms are specialized to such an extent that all other kinds of farming are excluded. Consumption of power on medium-sized dairy farms in 1947 increased by 865 kilowatt-hours for each five additional milk cows in the dairy herd. An average increase of five cows in the dairy herd, on the other hand, was associated with an average increase in gross farm income of \$2,000, and an average increase of more than 900 kilowatt-hours in the amount of electricity used in 1947.

Although income is the primary factor influencing consumption of electricity on farms, its influence, particularly on large farms, is modified by the type of farm and the resulting opportunities to employ electric appliances. Consumption for each \$1,000 of gross farm income increased on dairy farms, by about 425 kilowatt-hours; on poultry farms, by 473 kilowatt-hours; and on cash-crop farms, by 405 kilowatt-hours.

Of the major electric household appliances, refrigerators were in use on a larger number of farms and, generally speaking, they had been installed at an earlier date than electric ranges and water heaters. Other sources of energy offer no significant competition to electricity in refrigeration. Wood and oil ranges, equipped with coils for water heating, offer some competition to electric ranges and water heaters, particularly on farms that have low incomes. The density of electric farm appliances varies with the type of farm. Electric milking machines were available on more than half of all farms, and electric water heaters for farm use were as numerous as were water heaters in homes. Most of these appliances were connected during the 5-year period 1940-44. Multiple-purpose motors were reported on less than a third of the farms--they were generally small and primarily of a portable type. Of major significance in the competitive situation between electricity and other sources of energy on the farms is the fact

that almost half of all the farms visited were connected to city water systems. On most farms, however, at least one electrically operated water-pressure system was available. Milk cooling was done by using this water rather than by a special electric milk cooler.

Considerable variation in seasonal distribution of power consumption was found among farms of different sizes. On large farms, consumption during the first half of the year is comparatively high. On medium-sized and small farms, progressively smaller proportions of the annual consumption are used during the first half of the year. On large farms the difference between the seasonal patterns in 1941 and 1947 was not significant, but on medium and small farms rather extreme variations in the seasonal distribution apparently tended to level off. These differences may be traced to the varying proportion of farm and home consumption on different sizes of farms.

Average annual costs of electricity on farms in 1947 amounted to about \$65. This represents an increase in annual costs of 85 percent over 1938, which compares with an increase of 293 percent in average annual consumption during the same period. Average cost per kilowatt-hour through increased use and reductions in rate declined from 3.3 cents per kilowatt-hour in 1938 to 1.7 cents in 1947.

On dairy farms, consumption of electricity for household use exceeded that for farm use. The proportion of electricity used in the household increased as the size of farm declined. Of a total consumption in 1947 of almost 10,000 kilowatt-hours on large dairy farms, 53 percent were used in the households. On medium-sized dairy farms, which had an average consumption of 5,700 kilowatt-hours, 63 percent were used in the homes, and on small dairy farms with a total consumption of 3,400 kilowatt-hours, 72 percent were used for home lighting and household appliances. Compared with other types of farms, uses of electricity in farm operations are comparatively important, particularly on large dairy farms. Consumption of electricity on dairy farms shows a distinct seasonal variation which had not changed materially between 1941 and 1947.

Consumption of electricity on poultry farms in each size group exceeded that of other types of farms. Furthermore, this is the only type of farm on which farm use of electricity in the large- and medium-sized groups exceeded home use. On large poultry farms, farm use of electricity amounted to 64 percent of the total estimated use and on medium-sized poultry farms to 51 percent. Estimates of the consumption on poultry farms, particularly of large and medium sizes, were not so close to the actual consumption reported as was the case for other types of farms. The difficulty of ascertaining with reasonable accuracy the average use of electricity for lighting in poultry houses and farm appliances, as water heaters, brooders, etc., is probably the main reason for the discrepancies.

The relatively high consumption of electricity for farm use on poultry farms has apparently influenced considerably the seasonal pattern of use, which differs from that on other types of farms. Consumption during the first half of the year was considerably higher than during the second half. In 1947, however, some leveling off of the wide variation appears to have occurred.

Cash-crop farms are characterized by a relatively high household use of electricity, particularly on those that are large in both size and income. Farm use of electricity is comparatively small and does not exceed one-fourth of total consumption. Only on farms with considerable supplementary dairy or poultry enterprises which permit the use of electricity was the farm use important.

The seasonal pattern of consumption of power on cash-crop farms, influenced primarily by home use, showed no extreme fluctuations. Use of power for sprinkler irrigation appears to have contributed to a higher than usual consumption during July and August. The differences in seasonal pattern between 1941 and 1947 were minor, and were apparently caused primarily by differences in climatic conditions.

On part-time farms only a small amount of electricity was used in farming. When farm appliances were available, their use was so small that it did not materially influence the total use of power. Household use of electricity apparently was also smaller than on commercial types of farms. Estimated average annual consumption per appliance, as used for other farms, resulted in a total estimated use of electricity per farm household which exceeded the average consumption reported for part-time farms.

Of major interest in any study of the uses of electricity on farms is not only the analysis of the present uses, their extent by type and size of farm, and the historical trend during the last 10 years, but also the question of what the future trend in consumption is likely to be. This study provides the basis for an analysis of the power load that may be expected in the study area within the foreseeable future.

An analysis of future trends in the consumption of power would require an exhaustive study of the probable changes in agricultural production, the anticipated income levels, and the probable technical improvements involving the use of electricity, some of which are still in the experimental stage. It is not feasible to carry out such a study at this time, but an attempt has been made here to estimate conservatively the level of power consumption that may be expected in the area. For this purpose, it has been assumed that farm income for the next 10 to 15 years, centering around 1960, would remain at the 1946-48 level; that no major adjustments in production, which would involve changes as to types of farms existing in the area, would take place; that there would be no shortage of power, at least during the latter half of the projected period; and that enough appliances would be available to satisfy the demand. Price relationships between industrial and agricultural commodities are also assumed to remain at their present levels.

With these over-all assumptions in mind, separate estimates were prepared of expected consumption in households and in the farm business on farms of major types, sizes, and land classes. Table 46 shows the expected density of major home appliances and the estimated consumption of electricity by 1960 compared with the estimates for 1947, as made earlier in this study. The year 1960 was chosen for purposes of convenience to designate the period from 10 to 15 years hence and expected density of appliances or consumption indicated for that year are not to be used as forecasts but rather as indications of what may be expected during a 5-year period centering at that time.

It has previously been pointed out that estimates were conservatively made. This was purposely done to avoid suggesting increases in the level of consumption of electricity which are possible but which depend upon factors subject to different interpretations by different individuals. For example, no change has been made in the number of dwellings per farm or in the extent of use of lights or major household appliances. With an ample supply of electricity expected in the future, a higher use of kilowatt-hours may well be anticipated. The density of appliances expected by 1960 has been estimated for each type and size of farm and land class area separately, on the basis of dwellings per farm and density in 1947. In no case is complete saturation expected, although some farms--particularly the large farms with relatively high incomes--will approach this point in the case of refrigerators.

For freezer units, for which a considerable increase is foreseen, it is expected that the trend toward cabinet freezers of medium sizes will continue and that the increase in large walk-in freezers will be comparatively small. For this reason, an average consumption of 1,000 kilowatt-hours for all freezer units has been used, rather than a slightly lower use for cabinet freezers and twice this amount for walk-in freezers. The use of electricity in 1960 for other household appliances than those specified in table 46 will probably be relatively small, although many new or less common uses may be expected. Television, various types of heating by electricity, and other uses may well double the amounts of electricity indicated. On the other hand, further experimentation may result in some savings in present uses.

[illegible]

1/ Cabinet freezers, 900 kw.-hrs.; walk-in freezers, 1,800 kw.-hrs.

2/ Increase based on rounded figures.

# ESTIMATED FUTURE CONSUMPTION OF ELECTRICITY BY TYPE AND SIZE OF FARM

(NORTHWESTERN WASHINGTON)

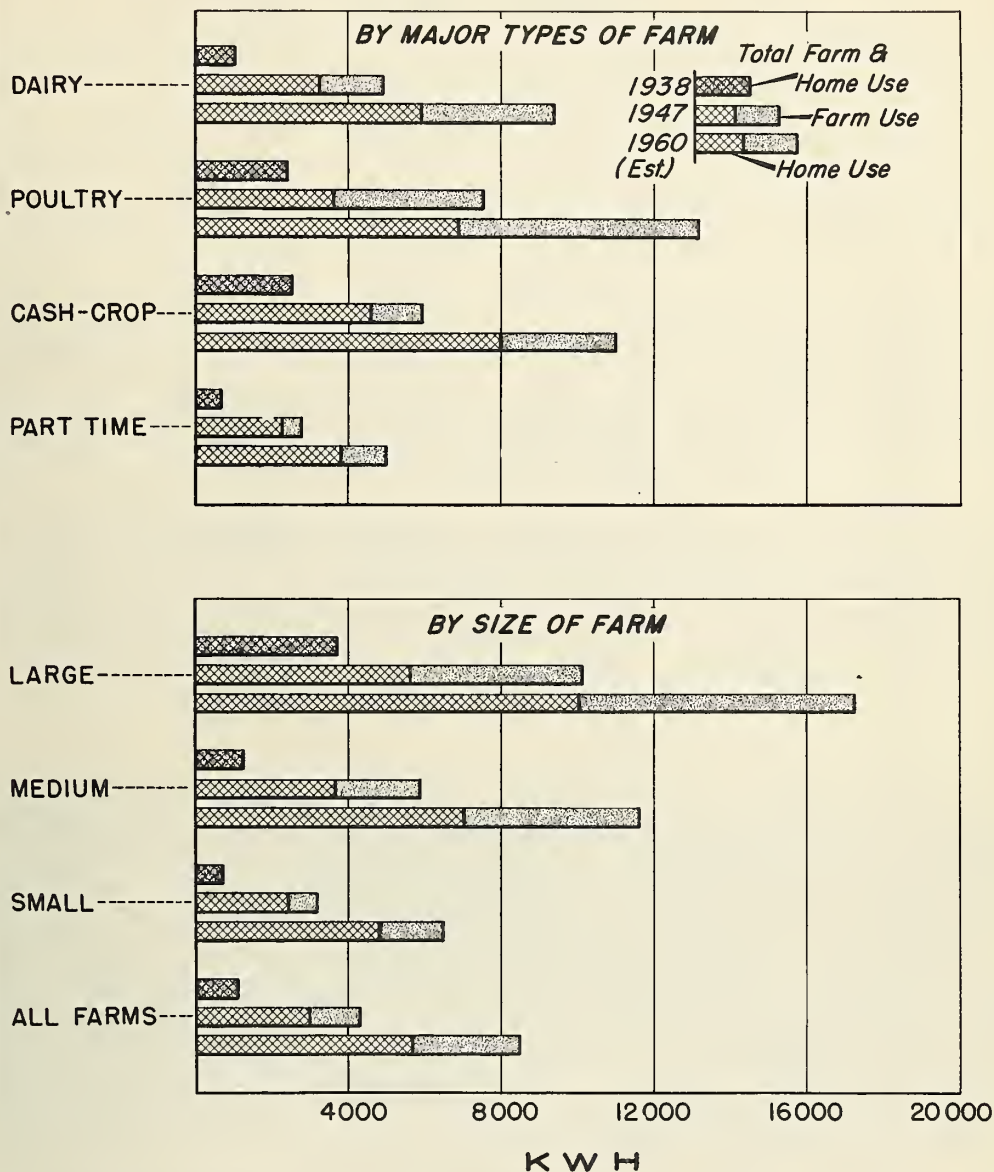


Figure 19. Consumption of electricity 10 to 15 years hence is likely to be about twice the consumption of 1947.

Table 47. - Consumption of electricity by major enterprises, by size and type of farm and land use, northwestern Washington, 1947 and expected 1960

Item	Dairy enterprise		Poultry enterprise		Other farm uses		Total farm use		Increase 1960 over 1947 1/	
	1947	1960	1947	1960	1947	1960	1947	1960	Quantity	Percent- age
	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.	Percent
Size of farm										
Large . . . . .	2,065	2,665	1,528	1,993	891	2,585	4,484	7,200	2,700	61
Medium . . . . .	1,530	1,942	441	699	248	1,988	2,219	4,600	2,400	109
Small . . . . .	427	686	61	240	197	759	685	1,700	1,000	146
Type of farm										
Dairy . . . . .	1,423	1,849	23	99	259	1,596	1,705	3,500	1,800	108
Poultry . . . . .	252	276	3,112	4,577	570	1,450	3,934	6,300	2,400	60
Cash-crop . . . . .	844	1,109	159	188	370	1,744	1,373	3,000	1,700	121
Part-time . . . . .	140	400	50	300	210	500	400	1,200	800	200
Land use										
Classes 1 and 2 . . . .	1,050	1,500	60	200	850	2,000	1,960	3,700	1,750	89
Class 3 . . . . .	1,000	1,500	200	300	105	1,200	1,305	3,000	1,700	130
Classes 4 and 5 . . . .	500	750	350	750	50	500	900	2,000	1,100	122
All farms . . . . .	798	1,118	271	492	270	1,172	1,339	2,800	1,400	108

1/ Increase based on rounded figures.

For the area as a whole, household consumption is expected almost to double during the next 10 to 15 years, with medium and small farms continuing the greater proportionate rate of increase. On large farms, however, consumption is expected to increase most in absolute terms.

In making estimates of prospective farm uses of electricity, no changes in distribution of farms as to types and sizes and no changes in size of individual enterprises have been considered. Estimates were prepared for individual major uses by enterprises, but only total consumption by these enterprises is given in table 47 for 1960, compared with consumption estimated for 1947.

Significant in the projection of power consumption on farms is the fact that increases in the dairy and poultry enterprises are expected to be minor. On the average of all farms in the area, consumption in dairy enterprises is expected to increase by 40 percent, that in poultry enterprises by 82 percent. Expressed in kilowatt-hours, the expected increase in dairy enterprises, however, is larger than that in poultry enterprises. Other farm uses of electricity are expected to show a major increase. Most of this increase may be accounted for by the use of electricity for supplementary irrigation on large and some medium-sized farms, chiefly of dairy and cash-crop types. Somewhat greater use may also be expected in regard to water pumping, shop, and general farm equipment.

Total farm uses of electricity by 1960, while expected to be twice as large as in 1947, will probably constitute only a third of the total use of electricity on the average of all farms in the area. In 1947, farm uses as a percentage of total uses were slightly less than a third. Small farms, both in household and farm uses, are expected to gain more proportionately but large farms show the largest gains in kilowatt-hours. Household and farm uses of electricity, estimated for 1947 and projected to 1960, are compared with total uses of electricity in figure 19 by types and sizes of farms.

Consumption of electricity on all farms in the area, which amounted to about 12 million kilowatt-hours in 1947, assuming no changes in number of farms or farm organization, is expected to reach 24-1/4 million kilowatt-hours annually 10 to 15 years hence. Such an increase points toward the need for careful planning in installation of adequate wiring on farms as well as construction of adequate generating, transmission, and distribution facilities.





## APPENDIX A

### Economic Land Use Classification

The Division of Agricultural Economics, Agricultural Experiment Stations, State College of Washington, has made studies leading toward an economic land use classification of all important farming areas of the State. The classifications of agricultural lands in many counties, including Skagit and Snohomish Counties, have been completed and presented in map form. Maps for other counties are in process of publication.

Physical and economic characteristics of land resources and their use are combined for the establishment of economic land use classes. Six classes have been mapped. Land class 3 areas are defined as those on which the usual farm family has an average level of living, and over a period of years, makes modest accumulations of capital. As the number changes from 3 to 1, the land becomes more productive and farm families have increased income opportunities. But as the number changes from 3 to 5, productivity of the land and income opportunities decline. Land class 6 in western Washington represents land areas that are suited only to forest and recreational uses, and in general are used only for these purposes.

Economic land use classification maps, therefore, are intended to show the income-producing capacity of agricultural areas. Within a given type-of-farming area they also indicate the intensity of land use. Class 1 is the most intensively used land and class 6 the least.

## APPENDIX B

### Sampling Procedure and Area Analysis

The sampling procedure used was dictated by the desire to secure an adequate number of records for statistical treatment for each type and size of farm and for each economic land use class area.

The distribution of types of farms and income classes by minor civil divisions of the Census of Agriculture for 1945 determined the types and sizes to be included in the study. Economic land use class areas were superimposed on a map of the study area showing minor civil divisions and a sample was taken within each land use class.

It was soon found that outstanding changes in types and sizes of farms had taken place between 1947, the last complete year on the basis of which farm classification was made, and 1944, the year to which Census data applied. Probably the most important change during the intervening 3-year period occurred in poultry farms. There were fewer poultry farms of practically all sizes in 1947 than was indicated in the Census. Because of an unfavorable egg-feed ratio a number of farmers discontinued the poultry enterprise or greatly reduced it. To overcome this difficulty, an effort was made to obtain records for poultry farms of all sizes and in all land classes by using producer lists of the main poultry cooperative associations.

Further attempts were made to add to the original sample for any size, type, or land class group that numbered less than ten records in order to provide what the authors considered would be a minimum number of records in each sub-group. For some of the subclasses it was found impractical to obtain even a minimum of ten records because they occurred so infrequently in the total population. For example, large dairy or cash-crop farms on land classes 4 and 5, or poultry farms on land classes 1 and 2 occur so infrequently in the area that it was impossible to find a minimum sample of even ten records.

In order to present data by land class areas and for the area as a whole, a method of weighting based upon a random sample survey for approximately the same area taken in April 1948 was employed. <sup>9/</sup> This survey used the area sampling technique to obtain a random sample of farms

<sup>9/</sup> The distribution of farms by type and size within each land class was based upon a study by the Division of Agricultural Economics, the State College of Washington, made immediately following the completion of the field survey for this study. The results are available in an unpublished thesis by Pa-Chun Li entitled, A Study of Farm Characteristics by Economic Land Use Class, Skagit County, Washington, 1947-48.

(using the United States Census definition of a farm), by economic land use classes. It was assumed in reconstructing data for presentation by land classes and for the total area that: (1) The averages for each size and type group in this study were representative of the same segment (size and type group) in the entire population of the study area. (2) The distribution of farms by size and type in each land class in the study area was similar to the distribution found in the April 1948 survey. The estimate for the total population was based on a farm count for the study area. Neither of these assumptions can be proven statistically, but they appear to be reasonable assumptions to the authors. Major weights, by type and size of farm and by economic land use class, are given in table 48.

Table 48.- Weights used in area analysis, by size and type of farm and land use, northwestern Washington.

Item	Land use, all sizes					
	Dairy	Poultry	Cash-crop	Part-time	Subsistence	All types
	Percent	Percent	Percent	Percent	Percent	Percent
Land use						
Classes 1 and 2 . . . . .	30.5	11.8	92.9	15.3	---	26.6
Class 3 . . . . .	22.6	11.8	7.1	14.3	---	15.9
Classes 4 and 5 . . . . .	46.9	76.4	---	70.4	100.0	57.5
Total . . . . .	100.0	100.0	100.0	100.0	100.0	100.0
Item	Land use, all types					
	Classes 1 and 2	Class 3	Classes 4 and 5	All classes		
	Percent	Percent	Percent	Percent		
Size						
Large . . . . .	23.9	7.7	2.6	9.1		
Medium . . . . .	39.2	20.6	10.9	20.0		
Small . . . . .	36.9	71.7	86.5	70.9		
Total . . . . .	100.0	100.0	100.0	100.0		
Item	Size of farm, all land use					
	Large	Medium	Small	All sizes		
	Percent	Percent	Percent	Percent		
Type						
Dairy . . . . .	8.3	31.1	60.6	100.0		
Poultry . . . . .	23.6	41.0	35.4	100.0		
Cash-crop . . . . .	46.0	35.4	18.6	100.0		
Part-time . . . . .	---	---	100.0	100.0		
Subsistence . . . . .	---	---	100.0	100.0		
Total . . . . .	9.1	20.0	70.9	100.0		

In line with the main purpose of the study which was to ascertain the uses of electricity on commercial farms, no special effort was made to secure an adequate sample of subsistence farms. However, records were taken on all part-time farms which were included in the original sample. Since all of them were of small size and most of them were located near towns, their total number in the sample was small in relation to the main types of commercial farms.

All records obtained were currently classified in the field by type, size, and economic land use class.

## APPENDIX C

Farm Classifications Used

**Type Classification.** The classification of farms by types follows closely that used by the Census of Agriculture, that is, a classification on the basis of income. If 50 percent or more of the gross farm income in 1947 was derived from one single farm enterprise, the farm was classified as a specialty farm of the predominant enterprise. If two enterprises combined contributed more than 50 percent of the gross farm income, the farm was classified as a combination farm of those enterprises that contributed the highest proportions. Part-time farms were those on which the income from outside sources exceeded the farm income and the time spent by the operator and his family in farm work was less than 50 percent of the time normally spent on full-time small farms. If the value of farm products used in the home amounted to 50 percent or more of the gross farm income, the farm was classified as of subsistence type.

Using this type classification, in which only 50 percent of the gross farm income represents the dividing point, it will be found that most farms are of a specific type, and that very few can be classified as combination or general types. On the other hand, practically no farms are without supplementary enterprises, some of which may become the main enterprise in years of different price relationships between major commodities. For example, a dairy farm with a relatively large acreage in specialty crops of relatively high value, on the basis of gross farm income may be classified one year as a dairy farm, but in another year as a combination dairy and cash-crop farm.

**Size Classification.** Several different measures may be used to classify farms by sizes. Some of the recognized measures are acres operated, acres in crops, capital investment, farm income, numbers of livestock, and amount of labor required for various enterprises found on the farm. In this study the last mentioned measure has been used.

Labor input is expressed in standard productive man work units (PMWU) applicable to a particular farming area. A productive man work unit is the amount of productive work accomplished by a man in a 10-hour day, working at the average rate for the region. For example, 1 acre of mixed hay on which two cuttings are made represents 1.2 productive man-work units as under average conditions it takes a man about 12 hours to do the necessary work on an acre of mixed hay, cut twice in western Washington. The average time required to care for a dairy cow under the conditions in western Washington is about 135 hours. Therefore, each cow is counted as 13.5 productive man work units. In this way, PMWU standards were applied to all crops and livestock on the farms surveyed and the total for the particular farm determined the size of farm business. Small farms were defined as those of 250 PMWU or under. In general these farms required about one full-time man to operate them. Medium-sized farms were classified as those having between 250 and 500 PMWU per farm. They usually required from one to two full-time men to operate them. Large size farms were those of over 500 PMWU. They usually required more than two full-time men in their operation.

In order to illustrate the insignificance in results if farms of a given type are classified on two different bases, all dairy farms have been classified first on the basis of PMWU and second on the basis of number of milk cows (table 49). Average consumption of electricity in 1947 is shown for both of these classifications.

Table 49.- Classification of dairy farms on the basis of productive man work units and number of milk cows, by size of farm

Size of farm	Classification	Farms	Milk cows	PMWU	Consumption of electricity in 1947	
					Average	Range
		Number	Number	Number	Kw.-hrs.	Kw.-hrs.
Large . . . . .	PMWU	46	39.8	795	9,984	800-25,100
	Milk cows	37	41.7	797	10,422	1,700-25,100
Medium . . . . .	PMWU	96	19.8	357	5,708	500-15,000
	Milk cows	121	19.7	360	5,581	500-15,000
Small . . . . .	PMWU	89	10.1	172	3,462	100-14,400
	Milk cows	73	9.1	167	3,364	100-14,400
Total . . . . .	PMWU	231	20.1	372	5,694	100-25,100
	Milk cows	231	20.1	372	5,694	100-25,100

Table 50.- Utilization of cropland and average number of livestock by size, land use, and type of farm, northwestern Washington, 1947.

Item	Large			Medium			Small		
	Classes :	Class :	Classes :	Classes :	Class :	Classes :	Classes :	Class :	Classes :
	1 and 2 :	3 :	4 and 5 :	1 and 2 :	3 :	4 and 5 :	1 and 2 :	3 :	4 and 5 :
	Number	Number	Number	Number	Number	Number	Number	Number	Number
DAIRY FARMS . . . . .	32	11	---	50	27	19	29	26	34
Acreage per farm reporting :	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>
Row crops . . . . .	17.6	11.3	---	5.8	4.1	7.3	2.5	5.1	.2
Vegetables . . . . .	24.9	20.0	---	14.8	18.2	---	7.4	6.3	---
Grain . . . . .	21.0	24.6	---	9.2	8.7	11.9	8.0	7.3	4.9
Forage, hay or silage . . . . .	30.8	31.4	---	15.1	21.7	22.7	10.4	10.9	11.6
Small fruits . . . . .	7.0	20.0	---	---	2.0	---	---	---	.6
Bulbs . . . . .	12.0	---	---	---	2.0	---	---	---	---
Total crops . . . . .	69.7	53.7	---	26.3	28.2	29.5	12.9	14.4	12.5
Total land operated . . . . .	162.6	125.5	---	50.5	86.4	95.4	29.2	38.5	52.2
Livestock per farm reporting:	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>
Dairy cows . . . . .	38.4	44.5	---	19.8	20.4	18.8	10.5	10.7	9.6
Dairy heifers . . . . .	11.7	17.8	---	5.9	7.0	9.5	4.4	4.0	3.6
Hens and pullets . . . . .	39.2	430.0	---	156.9	59.0	116.7	40.0	20.0	40.0
CASH-CROP FARMS . . . . .	24	---	---	20	---	---	20	---	---
Acreage per farm reporting :	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>
Row crops . . . . .	28.5	---	---	5.0	---	---	11.0	---	---
Vegetables . . . . .	47.4	---	---	37.7	---	---	27.0	---	---
Grain . . . . .	39.6	---	---	22.7	---	---	34.5	---	---
Forage, hay or silage . . . . .	38.1	---	---	23.3	---	---	19.6	---	---
Small fruits . . . . .	32.5	---	---	9.0	---	---	2.0	---	---
Bulbs . . . . .	23.5	---	---	5.0	---	---	3.4	---	---
Total crops . . . . .	121.9	---	---	70.7	---	---	34.0	---	---
Total land operated . . . . .	167.2	---	---	106.5	---	---	45.6	---	---
Livestock per farm reporting:	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>
Dairy cows . . . . .	19.3	---	---	7.3	---	---	4.2	---	---
Dairy heifers . . . . .	12.3	---	---	5.2	---	---	4.8	---	---
Hens and pullets . . . . .	25.0	---	---	52.5	---	---	39.2	---	---
POULTRY FARMS . . . . .	---	---	20	---	10	20	---	9	35
Acreage per farm reporting :	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>
Row crops . . . . .	---	---	8.5	---	2.0	---	---	---	.5
Vegetables . . . . .	---	---	---	---	1.0	---	---	---	---
Grain . . . . .	---	---	10.0	---	6.8	3.0	---	---	---
Forage, hay or silage . . . . .	---	---	8.9	---	14.8	7.5	---	5.3	7.7
Small fruits . . . . .	---	---	4.7	---	---	.1	---	1.0	.9
Bulbs . . . . .	---	---	.2	---	---	---	---	---	---
Orchards . . . . .	---	---	---	---	---	---	---	.8	---
Total crops . . . . .	---	---	11.5	---	18.5	7.9	---	3.6	6.4
Total land operated . . . . .	---	---	53.0	---	29.7	37.6	---	6.9	16.6
Livestock per farm reporting:	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>
Dairy cows . . . . .	---	---	2.6	---	8.1	2.9	---	3.0	3.1
Dairy heifers . . . . .	---	---	2.6	---	4.0	2.1	---	2.3	2.8
Hens and pullets . . . . .	---	---	2,478.1	---	930.0	1,305.9	---	524.4	449.4
Turkeys . . . . .	---	---	5,380.0	---	1,500.0	2,800.0	---	---	---
PART-TIME FARMS . . . . .	---	---	---	---	---	---	8	8	26
Acreage per farm reporting :	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>	<u>Acres</u>
Row crops . . . . .	---	---	---	---	---	---	---	---	9.0
Vegetables . . . . .	---	---	---	---	---	---	5.5	---	---
Grain . . . . .	---	---	---	---	---	---	5.0	---	---
Forage, hay or silage . . . . .	---	---	---	---	---	---	4.3	10.2	8.3
Small fruits . . . . .	---	---	---	---	---	---	1.0	---	1.7
Bulbs . . . . .	---	---	---	---	---	---	---	---	---
Orchards . . . . .	---	---	---	---	---	---	1.0	---	5.0
Total crops . . . . .	---	---	---	---	---	---	5.1	10.2	8.3
Total land operated . . . . .	---	---	---	---	---	---	10.1	43.8	27.1
Livestock per farm reporting:	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>	<u>Number</u>
Dairy cows . . . . .	---	---	---	---	---	---	4.3	5.1	4.2
Dairy heifers . . . . .	---	---	---	---	---	---	2.3	2.5	3.3
Hens and pullets . . . . .	---	---	---	---	---	---	50.0	61.7	110.0

It may be noted that the average consumption of electricity in 1947 differed little between the two classifications--the difference amounting to less than 500 kilowatt-hours in any group.

For the size classification on the basis of number of cows, farms were arrayed by size of dairy enterprise from 3 to 99 cows. Approximately a third of the number of farms having the smallest numbers of cows were considered small, whereas all farms having the largest numbers up to approximately a third of the total number of cows were considered large. Thus, farms having from 3 to 12 milk cows were small, those with 13 to 30 milk cows were of medium size, and those with 31 to 99 milk cows were large. On the basis of PMWU, the number of milk cows ranges from 3 to 16 for small, 6 to 32 for medium, and 22 to 99 for large farms. When PMWU's are used as the measure for size classification, labor input for all enterprises on the farm, not just cows, determines the size classification. Thus, even farms having 6 milk cows were included in the medium-sized group, and farms having 22 cows were classified as large because of supplementary enterprises which increase the size of the farm business.

**Economic Land Use Classification.** The method used to classify farms according to physical and economic characteristics of their land resources was discussed in Appendix A. In the analysis of data obtained in this study, land classes 1 and 2 were combined to represent above average, that is, the most productive portions of the area. Likewise land classes 4 and 5 were combined to represent below average, that is, the least productive resources, respectively.

## APPENDIX D

### Organization of Farms

A summary of land utilization and number of livestock kept on farms is presented in table 50. When the number of farms in any group was below 8, averages were not shown.

Large dairy farms had an average of about 40 milk cows and about 10 dairy heifers. Other kinds of livestock were not numerous. Medium-sized dairy farms had from 18 to 20 milk cows, with about the same ratio of heifers to milk cows as on large farms. On a few of these, production of poultry was an important sideline. Small dairy farms averaged 10 milk cows. They had a proportionately larger number of dairy heifers than the large and medium-sized farms.

Dairy farms differed considerably in utilization of land by size of farm and economic land use classes. Large farms on the best land had about 16 acres more in crops than did those in land class 3, with the difference more than accounted for by a larger acreage in intensive crops such as canning peas and vegetable seeds. Large dairy farms on land class 3, on the other hand, had more grain and forage crops and about six more cows per farm than those on the more productive land.

On medium-sized and small dairy farms, total land operated increased somewhat as the quality of the resources declined. The proportion of the total land used for crops and open pastures, however, is smaller on less productive land than on the better land. On the more productive land, more than 90 percent of the acreage operated is used for crops and pastures, whereas in the least productive parts from about 50 to 60 percent of the land in farms is in crops or open pastures. Furthermore, more intensive crops were grown on medium-sized and small farms on the better land than was the case on land of lower productivity. On land classes 1 and 2, row crops, vegetables, and specialty crops offer strong competition to dairying, the main enterprise. When farms of approximately equal size based on PMWU's were compared, the greater intensity of land use on the best land was counter-balanced by increased cow numbers on the less productive land.

Farms with cash crops as the main type of enterprise were found on the better lands only. Approximately 90 percent of the total land in farms was used for production of crops or pasture. Less than 50 percent of the cropland was planted to grain and forage crops. In view of the fact that the land must be rotated among crops to maintain its productivity and that some of it is not suited to the specialty crops adapted to the area, the acreage devoted to grain and forage crops was relatively small.

The frequency of occurrence and size of acreage devoted to the various kinds of specialty crops on these farms differs somewhat with the size of farm. On the average of all cash-crop

Table 51. - Proportion of farms reporting connection to power line during specified periods, by size and type of farm and economic land use class, northwestern Washington

Item	Economic : land : use : classes :	Before : 1925 :		1925- : 29 :		1930- : 34 :		1935- : 39 :		1940- : 44 :		1945- : 46 :		1947 : :		Total : number : of farms : reporting :		Total : number : of all : farms : reporting :		Percent : Number : Percent	
		Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Percent	Number	Number	Percent	Percent	Number	Number	Percent	Percent
Size of farm																					
Large .....	1 and 2	37.0	50.0	9.3	---	---	---	3.7	---	---	---	---	---	---	---	54	60	10.0	---	---	---
	3	21.5	50.0	7.1	14.3	7.1	---	---	---	---	---	---	---	---	---	14	19	26.3	---	---	---
	4 and 5	13.6	45.5	18.2	18.2	4.5	---	---	---	---	---	---	---	---	---	22	28	21.4	---	---	---
	Total	28.9	48.9	11.1	6.7	4.4	---	---	---	---	---	---	---	---	---	90	107	15.9	---	---	---
Medium .....	1 and 2	36.2	38.0	8.6	10.3	1.7	---	---	---	---	---	---	---	---	---	58	71	18.3	---	---	---
	3	8.0	52.0	16.0	12.0	4.0	---	---	---	---	---	---	---	---	---	25	40	37.5	---	---	---
	4 and 5	21.9	43.8	21.9	6.2	6.2	---	---	---	---	---	---	---	---	---	32	44	27.3	---	---	---
	Total	26.1	42.6	13.9	9.6	3.5	---	---	---	---	---	---	---	---	---	115	155	25.8	---	---	---
Small .....	1 and 2	26.9	44.2	5.8	11.5	7.7	---	---	---	---	---	---	---	---	---	52	64	18.8	---	---	---
	3	23.7	28.9	18.4	15.8	10.5	---	---	---	---	---	---	---	---	---	38	51	25.5	---	---	---
	4 and 5	9.9	32.0	14.8	27.2	9.9	---	---	---	---	---	---	---	---	---	81	104	22.1	---	---	---
	Total	18.1	35.1	12.9	19.9	9.4	---	---	---	---	---	---	---	---	---	171	219	21.9	---	---	---
Type of farm																					
Dairy .....	1 and 2	42.8	37.4	5.5	7.7	4.4	---	---	---	---	---	---	---	---	---	91	111	18.0	---	---	---
	3	11.7	34.9	18.6	18.6	11.6	---	---	---	---	---	---	---	---	---	43	64	32.8	---	---	---
	4 and 5	11.3	36.4	25.0	18.2	6.8	---	---	---	---	---	---	---	---	---	44	56	21.4	---	---	---
	Total	27.5	36.5	13.5	12.9	6.8	---	---	---	---	---	---	---	---	---	178	231	22.9	---	---	---
Poultry .....	1 and 2	---	100.0	---	---	---	---	---	---	---	---	---	---	---	---	5	7	28.6	---	---	---
	3	30.8	53.8	---	7.7	7.7	---	---	---	---	---	---	---	---	---	13	21	38.1	---	---	---
	4 and 5	18.6	33.9	10.2	28.8	5.1	---	---	---	---	---	---	---	---	---	59	75	21.3	---	---	---
	Total	19.5	41.5	7.8	23.4	5.2	---	---	---	---	---	---	---	---	---	77	103	25.1	---	---	---
Cash-crop .....	1 and 2	24.6	49.1	12.3	7.0	1.7	---	---	---	---	---	---	---	---	---	57	64	10.9	---	---	---
	3	20.0	50.0	10.0	20.0	---	---	---	---	---	---	---	---	---	---	10	11	9.1	---	---	---
	4 and 5	---	62.5	25.0	---	12.5	---	---	---	---	---	---	---	---	---	8	14	42.9	---	---	---
	Total	21.3	50.7	13.3	8.0	2.7	---	---	---	---	---	---	---	---	---	75	89	15.7	---	---	---
Part-time .....	1 and 2	12.5	50.0	12.5	12.5	12.5	---	---	---	---	---	---	---	---	---	8	8	0.0	---	---	---
	3	14.3	28.6	42.8	---	---	---	---	---	---	---	---	---	---	---	7	8	12.5	---	---	---
	4 and 5	9.5	42.9	14.3	9.5	14.3	---	---	---	---	---	---	---	---	---	21	26	19.2	---	---	---
	Total	11.1	41.7	19.5	8.3	11.1	---	---	---	---	---	---	---	---	---	36	42	14.3	---	---	---
Miscellaneous .....	1 and 2	33.4	33.3	---	---	33.3	---	---	---	---	---	---	---	---	---	3	5	40.0	---	---	---
	3	50.0	50.0	---	---	---	---	---	---	---	---	---	---	---	---	4	6	33.3	---	---	---
	4 and 5	---	---	33.4	33.3	33.3	---	---	---	---	---	---	---	---	---	3	5	40.0	---	---	---
	Total	30.0	30.0	10.0	10.0	20.0	---	---	---	---	---	---	---	---	---	10	16	37.5	---	---	---
All farms .....	1 and 2	33.5	43.9	7.9	7.3	4.3	---	---	---	---	---	---	---	---	---	164	195	15.9	---	---	---
	3	18.2	40.2	15.6	14.3	7.8	---	---	---	---	---	---	---	---	---	77	110	30.0	---	---	---
	4 and 5	13.4	37.1	17.0	20.7	8.1	---	---	---	---	---	---	---	---	---	135	176	23.3	---	---	---
	Total	23.1	40.7	12.8	13.6	6.4	---	---	---	---	---	---	---	---	---	376	481	21.8	---	---	---

farms, however, peas and vegetable seeds took the lead. Almost all of these farms produced corn and potatoes also, but only the large cash-crop farms had a sizable acreage of small fruits. Bulbs were produced on only a few of the large farms, but on these they were an important specialty crop.

Production of livestock on cash-crop farms was confined almost exclusively to dairy production. The number of dairy cows kept was in a ratio of approximately 1 cow to 10 acres of crops in all three size groups. On many of these farms, full utilization of the available land resources, as well as of the feed crops grown in rotation, requires a dairy enterprise.

Poultry farms are generally more numerous on the less productive land. The size of the farm business is determined primarily by the size of the poultry enterprise, as less than 50 percent of the land included in these farms (except that in class 3) is used for crops and pasture. Where the quality of the land is relatively good, particularly in that part of the area that is in Skagit County, a few dairy cattle are kept on these farms. More than 75 percent of the available cropland is used for grain and forage crops, with minor acreages for row crops and small fruits.

The poultry enterprise may consist of a laying flock, as in the case of the small enterprises, or it may be devoted to production of poultry meat which is more prevalent on medium-sized and large farms, on which both broilers and turkeys are produced. Ordinarily, different kinds of poultry enterprises are not mixed on the same farm; that is, production of fryers and broilers is usually not carried on in connection with production of eggs.

The number of part-time farms for which farm records were obtained was relatively small in comparison with the number reported for the area. These farms are concentrated on land that has a relatively low productive capacity. Those on good land were usually found near towns or cities where opportunities for outside employment are numerous. On these, all of the land included in the farm is used for crops and pastures. On land classes 3, 4, and 5, part-time farms are generally larger in terms of total acreage, and a considerable area of woodland is included in each. On some the woodland is in process of being cleared, and the owners hope to become full-time farmers. Progress is slow, as on most of the farms the topography and soil are such that the land will be of little agricultural value when cleared.

Disregarding woodland, the acreage of cropland and pastures on most of the part-time farms varies between 10 and 15 acres. This is a larger acreage per farm than shown by most other studies of part-time farming on the west coast. Production of specialty crops is insignificant. A large proportion of the available land is used for forage crops or is pastured. A few of the part-time farms, particularly those on the better soils, produce grains and small fruits, or have small orchards. Even on less productive land some of these crops may occasionally be found.

Table 52. - Weighted average annual consumption of electricity on farms, by size and type of farm and economic land use class, northwestern Washington, 1938-47

Size, type, and land use class groupings	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	Increase	
	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.	Actual	Percent of 1938
By size and type of farm												
Large												
Dairy	3,385	3,612	4,648	5,318	5,621	6,182	6,307	7,507	8,334	10,333	6,948	205
Poultry	5,329	6,814	5,821	5,842	7,361	10,142	9,860	12,243	13,188	15,336	10,007	188
Cash-crop	3,343	3,678	4,353	4,354	5,858	5,462	5,950	6,933	7,223	8,660	5,317	159
Medium												
Dairy	929	1,129	1,601	2,033	2,390	2,724	3,082	3,761	4,417	5,606	4,877	503
Poultry	1,601	2,181	2,496	2,496	3,525	4,152	3,943	4,989	6,431	7,933	6,332	396
Cash-crop	2,198	2,404	2,610	2,942	3,434	3,740	3,812	4,146	4,798	4,778	2,580	117
Small												
Dairy	648	696	728	832	1,053	1,248	1,438	1,991	2,509	3,331	2,885	416
Poultry	1,259	1,230	1,019	1,288	1,588	1,891	1,873	2,342	2,033	3,178	1,919	152
Cash-crop	993	1,578	1,773	1,941	2,305	2,954	2,890	3,050	3,811	4,260	3,267	329
Part-time	644	658	875	734	874	1,173	1,308	1,664	1,981	2,260	1,616	251
Subsistence	874	1,110	1,210	1,383	2,738	3,332	2,544	3,158	3,706	3,860	2,986	342
By size of farm and economic land use class												
Large												
Classes 1 and 2	3,456	3,738	4,521	4,875	5,934	5,997	6,359	7,390	7,938	9,530	6,074	176
Class 3	4,529	5,967	6,193	6,135	6,282	7,341	6,760	8,412	8,587	10,381	5,852	129
Classes 4 and 5	4,148	4,771	4,451	4,728	6,293	8,560	8,708	10,179	12,385	15,084	10,936	284
Medium												
Classes 1 and 2	1,404	1,508	1,896	2,441	2,918	3,253	3,642	4,105	4,906	6,137	4,733	337
Class 3	951	1,314	1,699	1,836	2,303	2,726	2,882	3,818	4,486	5,690	4,739	498
Classes 4 and 5	999	1,265	1,770	2,074	2,535	2,941	2,969	3,876	4,652	5,351	4,352	436
Small												
Classes 1 and 2	1,167	1,174	1,242	1,508	1,583	1,650	1,802	2,403	3,189	3,511	2,344	201
Class 3	783	826	974	1,037	1,303	1,488	1,688	2,186	2,561	2,953	2,170	277
Classes 4 and 5	596	660	679	757	1,189	1,570	1,510	1,959	2,307	2,882	2,288	384
By type of farm and economic land use class												
Dairy												
Classes 1 and 2	1,513	1,803	2,013	2,578	2,868	3,231	3,603	4,222	4,995	6,387	4,874	322
Class 3	1,038	1,246	1,555	1,712	2,051	2,325	2,544	3,065	3,548	4,478	3,438	331
Classes 4 and 5	565	642	764	859	1,085	1,288	1,446	2,171	2,686	3,535	2,970	526
Poultry												
Classes 1 and 2	1,503	1,585	2,088	2,900	4,482	5,181	4,834	5,297	7,377	9,405	7,902	526
Class 3	4,040	6,030	4,872	4,212	4,705	6,345	5,352	8,989	9,204	5,164	5,164	128
Classes 4 and 5	2,234	2,456	2,367	2,843	3,483	4,458	4,459	5,331	8,035	7,593	5,359	240
Cash-crop												
Classes 1 and 2	2,618	2,864	3,314	3,480	4,453	4,417	4,683	5,321	5,769	8,529	3,911	149
Class 3	950	2,477	2,493	2,427	2,837	3,981	3,307	3,952	5,191	5,653	4,703	495
Classes 4 and 5	---	---	---	---	---	---	---	---	---	---	---	---
Part-time												
Classes 1 and 2	1,439	1,399	1,446	1,615	1,549	1,404	1,619	2,427	3,271	3,127	1,688	117
Class 3	733	718	673	677	791	760	1,052	1,794	1,881	1,904	1,171	160
Classes 4 and 5	453	485	508	554	745	1,208	1,293	1,471	1,722	2,144	1,691	373
Subsistence												
Classes 4 and 5	874	1,110	1,210	1,383	2,738	3,332	2,544	3,158	3,706	3,880	2,986	342

Table 53.- Computed consumption of electricity, by type and size of farm and land use, northwestern Washington, 1938-47 1/

Item	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	a	b
Dairy												
Large	3,485	3,902	4,369	4,892	5,478	6,134	7,360	7,691	8,612	9,643	3,112.2	1.1197
Medium	1,020	1,234	1,493	1,806	2,184	2,641	3,194	3,863	4,672	5,650	843.9	1.2091
Small	538	648	780	939	1,130	1,360	1,637	1,970	2,371	2,854	447.2	1.2036
Poultry												
Large	5,028	5,667	6,387	7,199	8,114	9,145	10,310	11,620	13,100	14,760	4,461.0	1.1271
Medium	1,555	1,854	2,211	2,625	3,144	3,749	4,470	5,330	6,356	7,579	1,303.9	1.1924
Small	1,044	1,160	1,288	1,430	1,588	1,764	1,959	2,176	2,417	2,684	939.9	1.1107
Cash-crop												
Large	3,413	3,772	4,168	4,606	5,090	5,625	6,216	6,869	7,591	8,394	3,088.7	1.1050
Medium	2,238	2,451	2,684	2,940	3,220	3,526	3,862	4,229	4,632	5,073	2,043.8	1.0952
Small	1,241	1,429	1,645	1,893	2,179	2,509	2,888	3,224	3,627	4,005	1,078.1	1.1511
Part-time												
Small	536	626	731	854	997	1,164	1,358	1,586	1,822	2,162	459.5	1.1675
Land use												
Classes 1 and 2	1,783	2,026	2,302	2,615	2,972	3,377	3,837	4,360	4,954	5,629	1,569.0	1.1363
Class 3	872	1,058	1,284	1,559	1,893	2,297	2,789	3,385	4,109	4,988	718.2	1.2139
Classes 4 and 5	681	814	974	1,165	1,393	1,664	1,992	2,383	2,850	3,408	569.1	1.1960
All farms												
Northwestern Washington	1,041	1,212	1,412	1,642	1,911	2,224	2,588	3,082	3,505	4,089	894.9	1.1631
Washington 2/	1,328	1,488	1,669	1,871	2,097	2,351	2,635	2,954	3,312	3,712	1,184.1	1.1212
United States 2/	838	886	936	991	1,048	1,109	1,173	1,240	1,312	1,387	792.4	1.0576

1/ Formula:  $Yc-ab^x$  X=units of one year with origin at 1938.

2/ All residential users.



Table 55.- Average consumption of electricity per farm, by type and size of farm and by tenure, northwestern Washington, 1938-47.

Type, size, and tenure	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	Farms reporting
	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.	Kw.-hrs.	Number
Dairy											
Large											
Full owner . . . .	3,232	3,474	4,491	5,309	5,849	6,536	8,741	8,088	8,932	10,354	29
Part owner . . . .	3,990	3,675	4,778	5,189	4,969	5,499	5,617	8,570	7,509	9,088	10
Tenant . . . . .	3,115	3,849	4,237	4,563	4,443	4,823	4,684	4,594	5,464	9,729	7
Medium											
Full owner . . . .	952	1,192	1,617	1,916	2,257	2,586	3,098	3,698	4,258	5,685	71
Part owner . . . .	692	708	1,118	1,735	2,478	2,787	3,151	3,695	4,588	5,751	12
Tenant . . . . .	1,249	1,391	2,067	3,139	3,422	3,884	3,478	4,434	5,158	5,902	13
Small											
Full owner . . . .	746	804	852	1,017	1,251	1,480	1,650	2,110	2,687	3,445	81
Part owner . . . .	539	706	682	640	728	853	1,039	1,633	1,708	3,213	5
Tenant . . . . .	490	414	540	473	564	1,218	1,437	2,929	4,487	4,342	3
All sizes											
Full owner . . . .	1,254	1,415	1,754	2,073	2,385	2,718	3,019	3,670	4,278	5,423	181
Part owner . . . .	1,804	1,734	2,201	2,748	3,121	3,354	3,673	4,378	5,128	8,517	27
Tenant . . . . .	1,695	1,982	2,489	3,166	3,293	3,697	3,529	4,273	5,164	6,864	23
Poultry											
Large											
Full owner . . . .	5,385	6,501	5,722	6,243	8,098	10,589	10,325	11,901	13,161	15,915	19
Part owner . . . .	8,290	11,732	11,013	7,138	7,000	11,733	11,884	19,485	18,777	21,707	4
Tenant . . . . .	---	---	---	---	---	---	---	---	---	---	---
Medium											
Full owner . . . .	1,491	1,671	1,981	2,008	2,405	2,744	2,495	3,883	5,533	8,701	27
Part owner . . . .	4,535	5,633	7,116	8,342	19,335	27,309	33,441	34,302	33,240	39,450	1
Tenant . . . . .	---	---	---	---	---	---	266	216	124	1,013	2
Small											
Full owner . . . .	1,202	1,229	1,173	1,465	1,937	2,284	2,185	2,817	2,557	3,658	48
Part owner . . . .	317	287	438	445	734	1,236	1,521	2,188	2,374	4,337	2
Tenant . . . . .	---	---	---	---	---	---	---	---	---	---	---
All sizes											
Full owner . . . .	2,123	2,461	2,399	2,665	3,406	4,145	3,977	4,931	5,588	6,864	94
Part owner . . . .	6,335	8,808	7,435	5,397	8,972	10,959	12,003	18,655	16,156	19,279	7
Tenant . . . . .	---	---	---	---	---	---	268	218	124	1,013	2
Cash-crop											
Large											
Full owner . . . .	3,421	3,418	3,907	3,954	6,288	5,911	6,414	7,729	8,529	9,677	20
Part owner . . . .	2,691	2,823	3,380	3,186	3,373	3,460	3,739	4,015	4,140	5,023	9
Tenant . . . . .	2,650	3,349	3,949	4,205	4,566	5,726	5,162	5,314	4,806	7,998	5
Medium											
Full owner . . . .	1,669	1,984	1,919	2,632	3,141	3,427	3,473	3,982	5,237	5,384	14
Part owner . . . .	2,945	2,831	3,378	3,029	3,131	4,172	4,395	4,645	4,742	5,712	5
Tenant . . . . .	1,413	1,753	1,981	2,100	2,441	2,659	2,873	2,967	2,737	2,839	7
Small											
Full owner . . . .	897	1,153	1,364	1,640	1,955	2,309	2,236	2,336	2,745	3,118	26
Part owner . . . .	868	1,168	1,348	1,100	1,279	2,200	1,845	2,961	4,239	8,362	3
Tenant . . . . .	---	---	---	---	---	---	---	---	---	---	---
All sizes											
Full owner . . . .	1,951	2,132	2,774	2,677	3,735	3,847	4,008	4,555	5,297	5,832	60
Part owner . . . .	2,516	2,604	3,126	2,772	2,932	3,447	3,598	4,014	4,335	5,462	17
Tenant . . . . .	1,928	2,418	2,789	2,977	3,328	3,937	3,828	3,945	3,599	4,872	12
Part-time											
Small											
Full owner . . . .	712	729	726	784	863	1,011	1,214	1,469	1,717	2,057	40
Part owner . . . .	1,317	1,225	1,078	1,399	3,431	7,630	5,843	7,142	8,206	4,753	1
Tenant . . . . .	416	217	271	536	468	478	588	5,778	8,114	8,964	1
Subsistence											
Small											
Full owner . . . .	874	1,110	1,210	1,383	3,738	3,332	2,544	3,158	3,706	3,860	3
Part owner . . . .	---	---	---	---	---	---	---	---	---	---	---
Tenant . . . . .	---	---	---	---	---	---	---	---	---	---	---
Miscellaneous											
All sizes											
Full owner . . . .	769	1,389	1,520	1,864	1,978	3,525	3,907	5,704	8,623	7,350	7
Part owner . . . .	420	410	494	769	904	877	1,111	1,638	3,477	4,328	3
Tenant . . . . .	2,677	2,660	3,698	3,950	4,252	4,807	4,555	5,070	4,849	8,939	3
All types											
All sizes											
Full owner . . . .	1,518	1,725	1,899	2,170	2,687	3,095	3,239	3,934	4,528	5,512	385
Part owner . . . .	2,456	2,734	3,070	3,020	3,506	4,311	4,610	5,729	8,252	7,684	55
Tenant . . . . .	1,819	2,135	2,628	3,095	3,308	3,782	3,540	4,188	4,533	8,198	41

Table 56.- Consumption of electricity in relation to gross farm income, by major types of farms, northwestern Washington, 1947.

Dairy farms				Poultry farms				Cash-crop farms				Part-time farms			
Number of records	Gross : farm : income : 1,000	Actual : consump- tion : 1,000	Computed : consump- tion : 1,000	Number of records	Gross : farm : income : 1,000	Actual : consump- tion : 1,000	Computed : consump- tion : 1,000	Number of records	Gross : farm : income : 1,000	Actual : consump- tion : 1,000	Computed : consump- tion : 1,000	Number of records	Gross : farm : income : 1,000	Actual : consump- tion : 1,000	Computed : consump- tion : 1,000
Number	Dollars	Kw.-hrs.	Kw.-hrs.	Number	Dollars	Kw.-hrs.	Kw.-hrs.	Number	Dollars	Kw.-hrs.	Kw.-hrs.	Number	Dollars	Kw.-hrs.	Kw.-hrs.
2	1	0.4	2.6	2	1	3.7	2.1	3	1	0.9	1.8	1	1	2.6	1.1
23	2	2.2	3.0	8	2	2.5	2.6	5	2	3.2	2.2	1	2	1.0	1.4
29	3	3.1	3.4	7	3	2.1	3.1	6	3	4.0	2.6	7	3	1.2	1.8
27	4	4.4	3.8	12	4	3.9	3.6	6	4	3.7	3.0	16	4	2.7	2.1
14	5	4.3	4.3	9	5	4.3	4.0	8	5	2.7	3.4	7	5	1.3	2.4
21	6	4.6	4.7	10	6	3.9	4.5	6	6	4.3	3.8	7	6	2.1	2.8
17	7	5.0	5.1	7	7	5.2	5.0	9	7	4.7	4.2	1	7	9.0	3.1
18	8	6.8	5.5	6	8	6.4	5.5	6	8	3.4	4.6	2	9	3.7	3.8
10	9	5.9	6.0	4	9	6.3	5.9	6	9	7.3	5.0				
14	10	6.9	6.4	3	10	3.4	6.4	2	10	1.7	5.4				
10	11	6.7	6.8	3	11	7.1	6.9	1	11	15.3	5.8				
9	12	9.0	7.2	3	12	2.3	7.3	2	12	5.1	6.2				
5	13	7.7	7.7	2	13	20.6	7.8	2	14	13.8	7.1				
2	14	7.8	8.1	3	14	9.9	8.3	1	15	1.1	7.5				
3	15	7.4	8.5	1	15	12.7	8.8	2	16	4.9	7.9				
2	16	8.8	8.9	3	16	10.5	9.2	2	19	5.1	9.1				
1	17	1.6	9.3	2	20	10.0	11.1	1	20	2.9	9.5				
5	18	9.4	9.8	2	21	5.3	11.6	1	21	1.5	9.9				
7	19	11.9	10.2	1	22	18.5	12.1	3	22	10.0	10.3				
21	22	12.2	11.0	2	24	8.4	13.0	2	23	11.2	10.7				
1	23	2.8	11.5	2	26	7.3	14.0	2	24	8.5	11.1				
1	25	9.5	11.9	2	27	8.8	14.4	1	26	12.9	11.9				
2	26	9.6	12.7	2	28	21.8	14.9	1	29	16.9	13.1				
1	28	15.7	14.0	1	36	32.2	18.7								
2	29	16.8	14.4												
1	30	19.6	14.9												
1	31	20.9	15.2												
N	231			N	98			N	78			N	42		
fy	1318.1			fy	606.9			fy	400.0			fy	95.4		
fx	1945			fx	937			fx	720			fx	190		
fx <sup>2</sup>	24,524			fx <sup>2</sup>	14,955			fx <sup>2</sup>	9,602			fx <sup>2</sup>	962		
fy <sup>2</sup>	9,741.07			fy <sup>2</sup>	6,194.39			fy <sup>2</sup>	2,710.34			fy <sup>2</sup>	285.56		
fxy	14,556.8			fxy	8,640.4			fxy	4,888.2			fxy	465.9		

Table 57.- Percentage of major electric home appliances connected during specified periods, by size of farm, northwestern Washington.

Date of connection	: : Large :	: : Medium :	: : Small :	: : All farms :
	: : Percent :	: : Percent :	: : Percent :	: : Percent :
	Electric Ranges			
Before 1935 .....	17.9	11.7	10.5	13.6
1935-1939 .....	17.9	8.3	10.5	12.5
1940-1944 .....	28.4	23.3	26.3	26.1
1945-1946 .....	13.4	28.3	29.9	23.4
1947 .....	22.4	28.4	22.8	24.4
	Refrigerators			
Before 1935 .....	10.5	4.7	3.1	5.5
1935-1939 .....	29.5	18.9	30.8	26.5
1940-1944 .....	39.0	38.6	36.6	37.8
1945-1946 .....	10.5	20.5	18.2	17.1
1947 .....	10.5	17.3	11.3	13.1
	Water Heaters			
Before 1935 .....	8.3	3.2	5.2	5.6
1935-1939 .....	15.0	4.8	5.2	8.3
1940-1944 .....	28.4	22.6	19.0	23.3
1945-1946 .....	25.0	33.9	41.3	33.3
1947 .....	23.3	35.5	29.3	29.5

Table 58.- Percentage of specified farm buildings and major farm appliances connected during specified periods, by size of farm, north western Washington.

Date of connection	Size of farm			All farms
	Large	Medium	Small	
	Percent	Percent	Percent	Percent
Milk House				
Before 1935 .....	60.4	51.2	47.1	51.8
1935-1939 .....	7.6	22.1	21.2	18.3
1940-1944 .....	15.1	9.3	7.0	9.8
1945-1946 .....	9.4	10.4	10.6	10.3
1947 .....	7.5	7.0	14.1	9.8
Poultry Laying House				
Before 1935 .....	68.3	60.7	56.2	59.7
1935-1939 .....	17.1	16.4	21.9	19.5
1940-1944 .....	14.6	13.1	10.5	12.0
1945-1946 .....	---	6.5	5.3	4.6
1947 .....	---	3.3	6.1	4.2
Milking Machine				
Before 1935 .....	34.9	12.2	9.6	16.6
1935-1939 .....	15.2	15.9	15.4	15.5
1940-1944 .....	31.8	41.1	27.9	33.9
1945-1946 .....	13.6	24.3	33.7	25.3
1947 .....	4.5	6.5	13.4	8.7
Water Heater				
Before 1935 .....	16.4	1.1	1.8	5.5
1935-1939 .....	14.5	11.2	9.1	11.6
1940-1944 .....	32.7	42.7	32.7	37.2
1945-1946 .....	18.2	29.2	27.3	25.6
1947 .....	18.2	15.8	29.1	20.1

Table 59.- Weighted average monthly consumption of electricity on all farms, by size of farm, northwestern Washington, 1941 and 1947

Month	Kilowatt-hours 1/											
	Large farms			Medium farms			Small farms			All farms		
	1941	1947		1941	1947		1941	1947		1941	1947	
January	463	927		212	500		86	260		145	370	
February	434	907		195	483		77	267		133	370	
March	434	833		179	455		65	249		122	345	
April	432	892		193	457		70	229		128	337	
May	434	886		169	450		69	232		123	337	
June	417	832		187	443		65	232		122	327	
July	398	875		160	460		66	226		115	333	
August	416	856		168	462		73	245		124	338	
September	374	795		167	468		75	243		121	339	
October	351	823		171	499		76	248		119	347	
November	419	890		202	546		91	267		142	382	
December	449	1029		224	594		95	284		153	415	
Total	5021	10546		2227	5817		908	2982		1547	4240	
Indices 2/												
January	114	116		128	114		122	115		120	116	
February	106	112		115	108		107	117		108	114	
March	106	100		102	99		87	106		97	103	
April	104	106		110	98		95	95		102	99	
May	104	104		92	94		92	94		97	97	
June	102	94		102	91		84	93		95	92	
July	94	99		82	93		84	88		87	92	
August	98	94		85	91		95	96		94	92	
September	87	84		83	91		96	93		90	91	
October	81	86		84	97		96	94		88	92	
November	98	94		103	107		119	101		107	102	
December	105	111		115	118		123	108		115	112	

1/ Actual monthly consumption, not corrected for growth during the year.

2/ Average for the year, corrected for growth during the year, equals 100.

Table 60.- Average monthly bill and average cost per kilowatt-hour at 1938 and 1947 rates for increasing amounts of consumption, northwestern Washington

Average monthly consumption	: Av. monthly bill			: Costs per kw.-hr.		
	: 1938	: 1947	: 1947	: 1938	: 1947	: 1947
	: Resid.	: Resid.	: All elec-	: Resid.	: Resid.	: All elec-
	: rate	: rate	: tric rate	: rate	: rate	: tric rate
Kilowatt-hours	: Dols.	Dols.	Dols.	: Cents	Cents	Cents
100 .....	: 3.80	2.72	4.50	: 3.8	2.7	4.5
200 .....	: 6.20	4.72	4.50	: 3.1	2.4	2.2
300 .....	: 7.60	6.72	4.71	: 2.5	2.2	1.6
400 .....	: 8.60	7.72	5.41	: 2.2	1.9	1.4
500 .....	: 9.60	8.72	6.11	: 1.9	1.7	1.2
600 .....	: 10.60	9.72	6.81	: 1.8	1.6	1.1
700 .....	: 11.60	10.72	7.51	: 1.7	1.5	1.1
800 .....	: 12.60	11.72	8.21	: 1.6	1.5	1.0
900 .....	: 13.60	12.72	8.91	: 1.5	1.4	1.0
1000 .....	: 14.60	13.72	9.61	: 1.5	1.4	1.0
1100 .....	: 15.60	14.72	10.61	: 1.4	1.3	1.0
1200 .....	: 16.60	15.72	11.61	: 1.4	1.3	1.0
1300 .....	: 17.60	16.72	12.61	: 1.4	1.3	1.0
1400 .....	: 18.60	17.72	13.61	: 1.3	1.3	1.0
1500 .....	: 19.60	18.72	14.61	: 1.3	1.2	1.0
1947	:			:		
Average large farms	:			:		
880 .....	: 13.40	12.52	8.77	: 1.5	1.4	1.0
Average medium farms	:			:		
485 .....	: 9.45	8.57	6.00	: 1.9	1.7	1.2
Average small farms	:			:		
250 .....	: 7.10	5.72	4.50	: 2.8	2.3	1.8

Table 61.- Weighted average cost per kilowatt-hour of electricity, by size and type of farm and economic land use class, northwestern Washington, 1947.

Item	1938	1939	1940	1941	1942	1943	1944	1945	1946	1947	Decrease 1938-1947
											Actual : Percent Cents :
Size											
Large	1.99	1.83	1.67	1.60	1.48	1.49	1.41	1.35	1.31	1.26	0.7 37
Medium	3.19	2.83	2.26	1.95	1.86	1.79	1.69	1.59	1.50	1.39	1.8 56
Small	4.17	3.83	3.38	2.97	2.48	2.27	2.11	1.89	1.82	1.75	2.4 58
Type											
Dairy	3.45	3.13	2.52	2.19	2.12	2.02	1.91	1.76	1.64	1.50	2.0 57
Poultry	2.17	1.95	1.97	1.84	1.65	1.58	1.49	1.41	1.39	1.36	.8 37
Cash-crop	2.33	2.19	1.91	1.82	1.61	1.69	1.55	1.47	1.42	1.35	1.0 42
Part-time	4.09	3.94	3.49	3.19	3.14	2.67	2.33	2.08	1.93	1.89	2.2 54
Subsistence	4.83	3.87	3.34	2.77	1.62	1.54	1.38	1.29	1.51	1.63	3.2 66
Land use											
Classes 1 and 2	2.65	2.52	2.13	1.92	1.82	1.80	1.70	1.60	1.51	1.42	1.2 46
Class 3	3.17	2.14	2.37	2.17	2.11	1.99	1.88	1.69	1.65	1.55	1.6 51
Classes 4 and 5	4.02	3.58	3.10	2.75	2.21	2.03	1.89	1.74	1.69	1.63	2.4 59
Northwestern Washington	3.27	2.97	2.54	2.27	2.03	1.94	1.81	1.68	1.62	1.54	1.7 53
State of Washington 1/	2/	2/	2.18	1.91	1.81	1.74	1.67	1.60	1.50	1.44	.7 3/ 34 3/
United States 1/	4.10	4.01	3.89	3.75	3.72	3.64	3.48	3.42	3.24	3.06	1.0 25

1/ All residential users, computed from data in Edison Electric Institute, Statistical Bulletin, 1938-1947.

2/ Not available.

3/ For the period 1940 to 1947.

Table 62.- Electric household appliances per 100 farms on dairy farms, by size of farm, northwestern Washington, 1947.

Appliance	Large	Medium	Small
	Number	Number	Number
Farms . . . . .	46	96	89
Blankets . . . . .	2	1	2
Broilers . . . . .	4	1	2
Clocks . . . . .	146	124	74
Dishwashers . . . . .	2	---	1
Exhaust fans . . . . .	6	1	3
Food mixers . . . . .	65	55	33
Cabinet freezers . . . . .	11	1	1
Walk-in freezers . . . . .	---	1	1
Heating pads . . . . .	33	43	38
Hot-air circulating fans . . . . .	28	18	12
Hot water pumps . . . . .	6	1	4
Hot plates . . . . .	70	72	78
Irons . . . . .	120	107	99
Ironers . . . . .	24	6	3
Oil furnaces (elec. operated) . . . . .	24	6	8
Percolators . . . . .	56	42	44
Radios . . . . .	191	171	158
Ranges . . . . .	67	52	26
Refrigerators . . . . .	106	91	84
Roasters . . . . .	9	2	4
Sewing machines . . . . .	26	28	15
Space heaters . . . . .	20	19	20
Toasters . . . . .	87	80	75
Vacuum cleaners . . . . .	89	80	57
Waffle irons . . . . .	80	79	68
Washing machines . . . . .	111	99	98
Water heaters . . . . .	72	46	29

Table 63.- Electric farm appliances per 100 farms on dairy farms, by size of farm, northwestern Washington, 1947.

Appliance	Large	Medium	Small
	Number	Number	Number
Farms . . . . .	46	96	89
Dairy appliances			
Milking machine . . . . .	98	90	79
Milk cooler . . . . .	9	2	1
Water heater . . . . .	87	79	51
Poultry appliances			
Brooder . . . . .	7	18	12
Incubators . . . . .	---	---	---
Farm equipment			
Roughage elevator . . . . .	4	3	---
Ensilage cutter . . . . .	2	1	3
Hay hoist . . . . .	2	4	3
Feed grinder . . . . .	2	1	1
Feed chopper . . . . .	2	1	---
Feed mixer . . . . .	2	---	---
Electric fence . . . . .	67	77	76
Water pumping . . . . .	80	71	79
Farm shop			
Woodsaw . . . . .	2	1	1
Air compressor . . . . .	17	3	2
Drill press . . . . .	17	12	7
Tool grinder . . . . .	48	44	31
Power saw . . . . .	13	15	9
Welder . . . . .	4	2	1
Battery charger . . . . .	---	3	1
Lathe . . . . .	2	3	1
Forge . . . . .	2	4	1
Concrete mixer . . . . .	8	21	7
Soldering iron . . . . .	13	7	9
Electric drill . . . . .	6	3	3

Table 64.- Electric household appliances per 100 farms on poultry farms, by size of farm, northwestern Washington, 1947.

Appliance	Large	Medium	Small
	Number	Number	Number
Farms . . . . .	23	30	50
Blankets . . . . .	9	3	4
Broilers . . . . .	4	---	2
Clocks . . . . .	165	123	88
Dishwashers . . . . .	---	---	2
Exhaust fans . . . . .	9	3	---
Food mixers . . . . .	78	37	42
Cabinet freezers . . . . .	22	---	4
Walk-in freezers . . . . .	---	3	---
Heating pads . . . . .	52	53	44
Hot-air circulating fans . . . . .	26	33	20
Hot water pumps . . . . .	4	3	2
Hot plates . . . . .	104	53	58
Irons . . . . .	152	100	94
Ironers . . . . .	17	17	6
Oil furnaces (elec. operated) . . . . .	30	13	2
Percolators . . . . .	52	30	26
Radios . . . . .	239	153	132
Ranges . . . . .	61	37	30
Refrigerators . . . . .	117	87	60
Roasters . . . . .	13	---	4
Sewing machines . . . . .	44	23	10
Space heaters . . . . .	83	37	10
Toasters . . . . .	122	70	78
Vacuum cleaners . . . . .	91	70	68
Waffle irons . . . . .	109	83	72
Washing machines . . . . .	126	93	90
Water heaters . . . . .	70	43	30

Table 65.- Electric farm appliances per 100 farms on poultry farms, by size of farm, northwestern Washington, 1947.

Appliance	Large	Medium	Small
	Number	Number	Number
Farms . . . . .	23	30	50
Dairy appliances			
Milking machine . . . . .	26	23	14
Milk cooler . . . . .	4	---	---
Water heater . . . . .	13	17	4
Poultry appliances			
Brooder . . . . .	65	47	62
Incubator . . . . .	30	7	4
Farm equipment			
Roughage elevator . . . . .	---	3	---
Ensilage cutter . . . . .	---	---	---
Hay hoist . . . . .	---	---	---
Feed grinder . . . . .	9	---	---
Feed chopper . . . . .	---	3	---
Feed mixer . . . . .	9	3	---
Electric fence . . . . .	52	40	32
Water pumping . . . . .	109	73	86
Farm shop			
Woodsaw . . . . .	---	---	---
Air compressor . . . . .	4	---	---
Drill press . . . . .	13	7	2
Tool grinder . . . . .	43	20	20
Power saw . . . . .	43	13	8
Welder . . . . .	9	6	---
Battery charger . . . . .	4	---	2
Lathe . . . . .	4	---	---
Forge . . . . .	4	---	---
Concrete mixer . . . . .	4	13	4
Electric drill . . . . .	7	3	---
Soldering iron . . . . .	26	7	6

Table 66.- Electric household appliances per 100 farms on cash-crop farms, by size of farm, northwestern Washington, 1947.

Appliance	Large	Medium	Small
	Number	Number	Number
Farms . . . . .	34	26	29
Blankets . . . . .	21	19	10
Broilers . . . . .	26	4	3
Clocks . . . . .	135	104	79
Dishwashers . . . . .	9	4	---
Exhaust fans . . . . .	26	8	---
Food mixers . . . . .	62	65	34
Cabinet freezers . . . . .	9	8	---
Walk-in freezers . . . . .	12	---	---
Heating pads . . . . .	53	23	45
Hot-air circulating fans . . . . .	32	38	38
Hot water pumps . . . . .	---	4	---
Hot plates . . . . .	76	69	66
Irons . . . . .	118	100	100
Ironers . . . . .	12	15	10
Oil furnaces (elec. operated) . . . . .	21	15	17
Percolators . . . . .	50	42	45
Radios . . . . .	185	138	131
Ranges . . . . .	85	46	34
Refrigerators . . . . .	106	92	83
Roasters . . . . .	9	8	7
Sewing machines . . . . .	26	23	21
Space heaters . . . . .	41	23	31
Toasters . . . . .	106	77	76
Vacuum cleaners . . . . .	109	69	76
Waffle irons . . . . .	91	77	86
Washing machines . . . . .	106	85	93
Water heaters . . . . .	79	50	21

Table 67.- Electric farm appliances per 100 farms on cash-crop farms, by size of farm, northwestern Washington, 1947.

Appliance	Large	Medium	Small
	Number	Number	Number
Farms . . . . .	34	26	29
Dairy appliances			
Milking machine . . . . .	44	58	28
Milk cooler . . . . .	9	---	---
Water heater . . . . .	35	42	14
Poultry appliances			
Brooder . . . . .	9	8	14
Incubator . . . . .	---	---	---
Farm equipment			
Roughage elevator . . . . .	---	---	---
Ensilage cutter . . . . .	---	---	3
Hay hoist . . . . .	3	4	---
Feed grinder . . . . .	---	---	3
Feed chopper . . . . .	---	---	---
Feed mixer . . . . .	---	4	---
Electric fence . . . . .	41	61	45
Water pumping . . . . .	59	62	72
Farm shop			
Woodsaw . . . . .	---	---	---
Air compressor . . . . .	18	11	10
Drill press . . . . .	15	15	7
Tool grinder . . . . .	41	46	17
Power saw . . . . .	23	8	28
Welder . . . . .	6	12	7
Battery charger . . . . .	12	---	7
Lathe . . . . .	3	---	---
Forge . . . . .	---	---	---
Concrete mixer . . . . .	3	15	---
Soldering iron . . . . .	23	15	7
Electric drill . . . . .	6	---	---

Table 68.- Electric household appliances per 100 farms on part-time farms, by size of farms, northwestern Washington, 1947.

Appliance	Small
	Number
Farms . . . . .	42
Blankets . . . . .	7
Broilers . . . . .	2
Clocks . . . . .	86
Dishwashers . . . . .	---
Exhaust fans . . . . .	---
Food mixers . . . . .	45
Cabinet freezers . . . . .	2
Walk-in freezers . . . . .	---
Heating pads . . . . .	45
Hot-air circulating fans . . . . .	21
Hot water pumps . . . . .	---
Hot plates . . . . .	74
Irons . . . . .	102
Ironers . . . . .	14
Oil furnaces (elec. operated) . . . . .	10
Percolators . . . . .	45
Radios . . . . .	148
Ranges . . . . .	19
Refrigerators . . . . .	83
Roasters . . . . .	7
Sewing machines . . . . .	19
Space heaters . . . . .	21
Toasters . . . . .	62
Vacuum cleaners . . . . .	48
Waffle irons . . . . .	76
Washing machines . . . . .	95
Water heaters . . . . .	21

Table 69.- Electric farm appliances per 100 farms on part-time farms, by size of farm, northwestern Washington, 1947.

Appliance	Small
	Number
Farms . . . . .	42
Dairy appliances	
Milking machine . . . . .	38
Milk cooler . . . . .	---
Water heater . . . . .	5
Poultry appliances	
Brooder . . . . .	17
Incubator . . . . .	---
Farm equipment	
Roughage elevator . . . . .	---
Ensilage cutter . . . . .	---
Hay hoist . . . . .	---
Feed grinder . . . . .	2
Feed chopper . . . . .	---
Feed mixer . . . . .	---
Electric fence . . . . .	48
Water pumping . . . . .	74
Farm shop	
Woodsaw . . . . .	2
Drill press . . . . .	9
Tool grinder . . . . .	24
Air compressor . . . . .	---
Power saw . . . . .	12
Welder . . . . .	2
Battery charger . . . . .	---
Lathe . . . . .	2
Forge . . . . .	---
Concrete mixer . . . . .	9
Soldering iron . . . . .	12
Electric drill . . . . .	5

